The FOUNDRY

Volume 50
Number 22

Published
Semimonthly

CLEVELAND, OHIO, NOVEMBER 15, 1922

Shop Has Diversity of Methods

Nonferrous Metals Cast in Dies as Well as in Sand Molds—Both Oil and Water Pipes Cast in Crankcase—Die Castings Held within Close Limits for Dimensions

BY H. E. DILLER

HISTORY which records the discovery and utilization of the metal aluminum is inspiring to the manufacturer, confronted by a missing link in his process or to the inventor working on an intricate problem which is difficult of solution. The way in which obstacles were overcome in making a metal comparatively unknown before 1854, one of the most important of all metals in the manufacturing world, offers proper proof of the reward awaiting earnest application to scientific principles. First discovered by a French chemist named Baron, about 1760, little was done to make aluminum practical until 1854 when Wohler, a German chemist, and a French chemist by the name of Deville, determined its true properties. Research was continued and in 1855 the first company was organized to manufacture aluminum, at Rouen, France, but the price of the metal, due to the expense of production, was so high that it was impossible to sell it and the company disbanded one year after its formation.

Later a works was established at Amfreville, France, by a company headed by a Frenchman named Martin. This company operated successfully and sold the metal as low 32 cents per ounce. Deville also kept on perfecting the details of his process and finally, in connection with M. Rousseau he was able to produce it at such a low cost that he sold it for 22 cents per ounce.

Up to 1883 the Deville process was generally recognized as the only successful method for the manufacture of aluminum, and probably formed the link leading to the present electrolytic method which was invented by Charles M. Hall, Oberlin, O., patents on the method having been granted him in 1899. These

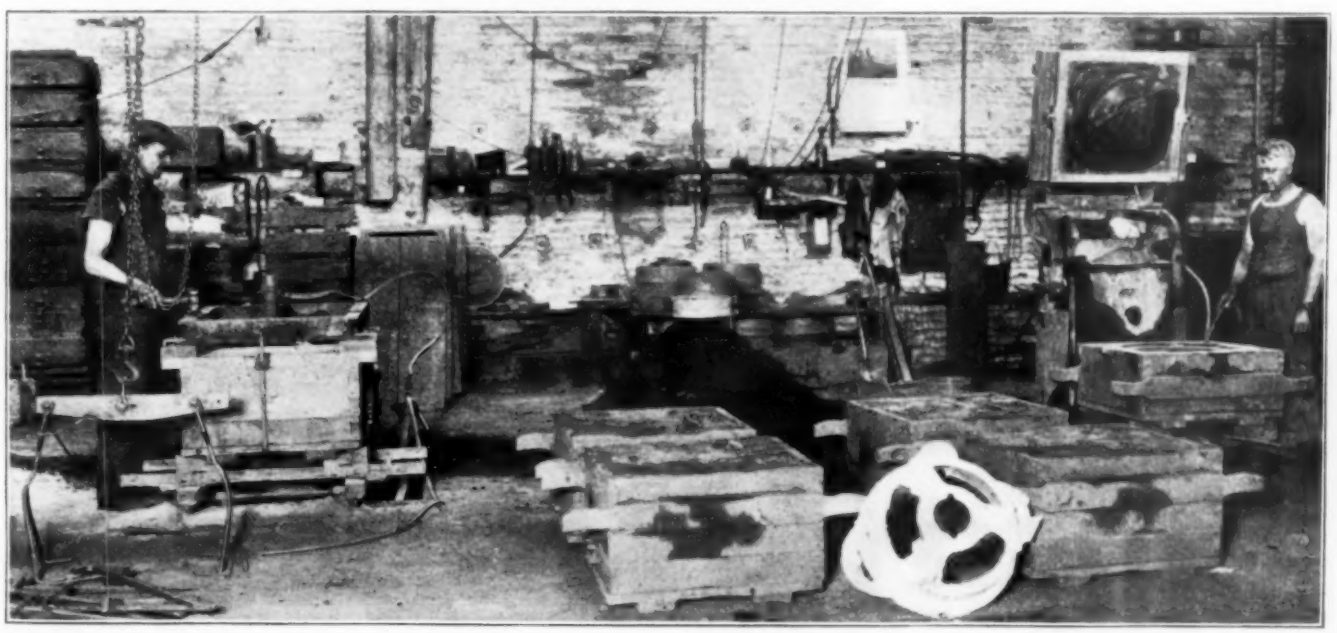


FIG. 1—BOTH COPE AND DRAG FOR A TRUCK CLUTCH HOUSING ARE MADE ON A HAND-RAM, POWER-ROLLOVER MACHINE—THE FLOOR IS SERVED BY AN I-BEAM TRAVELING CRANE

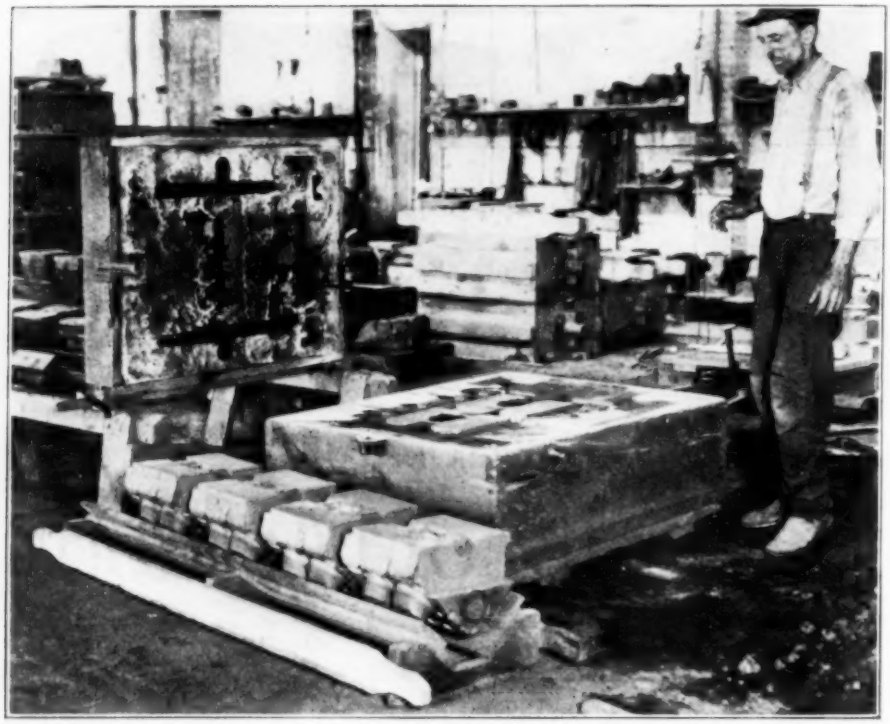


FIG. 2—SOME MOLDS FOR CRANKCASES ARE HAND MOLDED—THE COPE IS MADE ON A FLAT BOARD AND THE BODY OF THE DRAG IS FILLED WITH CORES

patents were secured by the Pittsburgh Reduction Co., which began the manufacture of the metal.

It is interesting, when considering the present price and rate of production of aluminum, to reflect that the Reduction company produced about 75 pounds of the metal per day in 1889 and sold it for $4.50 per pound. However, the increase in demand began at once and with it a reduction in the price. Thus, in 1890 the company increased its capacity to 400 pounds per day and sold the metal for $2.00 per pound.

Pioneers in Casting Aluminum

Since that time the strides have been rapid. As early as 1900 castings of aluminum alloys were made commercially by the Light Mfg. & Foundry Co. at its plant at Pottstown, Pa. This company, realizing the importance of this light metal to industry, started to develop aluminum alloys for use in castings for the automobile trade. The physical properties which it was able to guarantee were such that it secured a large contract for aluminum castings from the De Dion-Bouton Motorette Co. which was the first company to engage in the manufacture of gasoline automobiles on a large scale in this country.

The Light Mfg. & Foundry Co. has continued in the manufacture of such castings devoting its endeavors to quality rather than large production. This principle induced the company to establish a branch for the production of die castings which has grown rapidly until now a larger tonnage is made by the die-casting than by the sand-casting method. The methods of both these departments are of extreme interest and some of the principal features of each will be described.

Although machines of several types are used in the sand-casting foundry some castings are made by hand. One of these is the crankcase for an eight-cylinder car, the mold for which is shown in Fig. 2. The drag is rammed in the usual way, using a pattern board, and then the cores are placed. Chills consisting of oblong steel plates to which are welded C-shaped wires are placed over the pattern before the sand is rammed, the C-shaped wires acting as anchors to hold the chills in place in the mold. In addition to the plate chills a number of heavier chills are used at places where the section of the metal is heavy. In all 21 chills are employed in this mold.

Pipes Set in the Mold

Then the mold is rammed and struck off, after which the mold is turned over by the crane. Three small cores are set in, two for forming holes for the breather pipes and one for the hole for the oil pump shaft. Also the usual complement of cores consisting of two body cores in the middle, a fly-wheel core at one end and a timeing-gear core at the other, a leg core on each side of both end cores, two side cores and the journal cores are set in the drag. The unusual feature about this mold is that the ends of the body cores which face each other must be made in separate pieces to hold the copper water pipe which is cast in the crankcase. Besides the copper pipe a steel pipe for the oil line is set in the mold. This consists of a main pipe with three branch pipes extending from it. The main pipe rests against supports on the body cores and wires attached to the journal cores pull the branch pipes up and hold them in place.

Certain precautions were found necessary to secure a good mold when casting the pipes in place. The copper pipe which is ¾ inch in diameter is filled with dry sharp sand and plugged at each end with molding sand to support it. This diminishes the air within the

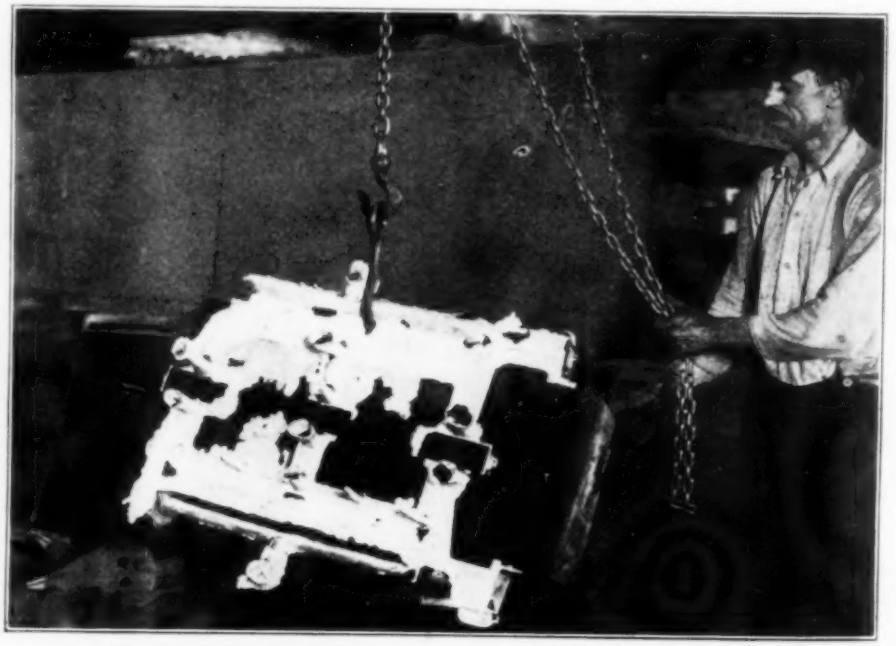


FIG. 3—CRANKCASE CASTINGS ARE LIFTED FROM THE MOLD AS SOON AS THE METAL SETS—NOTE THE TWO GATES, ONE ON EACH SIDE

pipe, which expands on being heated by the molten metal and must be carried off. Thus with sand in the pipe less air is carried off through the vent. The main branch of the steel pipe is partly filled by a solid steel rod, approximately the same diameter as the inside diameter of the pipe, then both ends are closed with molding sand. The branch pipes are nearly filled with sharp sand and the ends are stopped with molding sand.

Prevent Pipes from Warping

The cope is vented above the ends of the pipes to carry off the gas readily. The rod in the main pipe serves two purposes. It prevents the pipe from being warped by the heat from the molten metal when the mold is poured; it heats the pipe, being taken from the pipe shortly after pouring and placed in the next mold. Thus the pipe is heated sufficiently to assure that it will be dry when the aluminum is poured against it, so that no blows are caused. Also, the pipes are well sandblasted to remove scale which would cause a blow.

Fig. 2 shows the cope ready to be closed on the mold. At the end of the drag may be seen four body cores on the wooden carrier used to bring them from the core room to the molder. These carriers have a V-shaped trough in the center for the lower sides of the cores to rest against. The cope is rammed on a plain board marked for the riser and gate pins of which a large number are used. Two 1¼-inch risers are placed at each end and 4 across the center of the mold. Besides these 6 vent holes ¾-inch in diameter are placed at different places in the cope. The two down gates are set, one on each side of the mold. These are connected to the castings by runners, each with three finger gates, as may be noted from the cope in Fig. 2.

FIG. 5—SMALL MOLDS ARE MADE ON A ROLLOVER SQUEEZE MACHINE WHICH HANDLES BOTH COPE AND DRAG SIMULTANEOUSLY

Three molders make 12 of these molds a day using only two flasks. As soon as the mold is made it is poured, then while it is cooling and being shaken out another mold is made in the second flask. Fig. 3 shows the top of one of the castings after it has been shaken out it is carried by the crane to the knock-out floor to have the cores removed. Note the two risers at each end and the four across the center. The gates on both sides also may be seen. These castings and molds are handled by a 1-ton traveling crane, operated from the floor and equipped with chain falls. The shop also is equipped with two 2-ton cranes of the same design. All of these cranes were supplied by the J. W. Paxson Co., Philadelphia.

An example of the larger molds made on a machine is that for a clutch housing for a truck, a floor of which is shown in Fig. 1. Hand-ram, power-rollover, pattern-draw machines built by the Tabor Mfg. Co., Philadelphia, of which the Light company has 6, are used for making this mold. The casting is of comparatively simple design as may be noted from that shown in the foreground of Fig. 1. Only two cores are used. One small core forms a hole through the pad and another for the clutch shaft.

Parting Dusted on Mold

The two molding machines are identical, the drag pattern being attached to the one and the cope pattern to the other. After the mold is rammed and the bottom board has been clamped on, the whole is rolled over by air power. The drag flask shown on the machine at the left has been rolled over and after the clamps are taken off will be ready to draw the pattern. Before the pattern is drawn the molder raps the support on both sides of the mold. One of these supports is shown under his hammer. A vibrator is set working and the pattern is raised by air power, leaving the mold on the arm of the machine. The face of the mold is dusted with parting before the mold is closed. The machine at the right shows the pattern drawn and being turned back to the starting position.

Usually six of these molds are made and then all are poured off. They are

FIG. 4—GAS-FIRED FURNACES MELT THE ALUMINUM—A FEW OF THESE ARE SHOWN—NOTE THE PYROMETER ON THE POST AT THE CENTER

poured two-up from down gates on opposite corners each with two runners to the casting. After the molds are shaken out the sand is cut by one of the molders and put through the riddle shown behind the sand pile in the center. To dump the molds, a wooden horse is placed on the floor and the flask is dropped on it. When the pile of sand begins to get too deep the horse is moved to another position.

Smaller molds are made on the bench and on hand-squeeze, pattern-draw, roll-over machines furnished by the American Foundry & Equipment Co., New York. Fig. 5 illustrates one of the machines with a mold for a motor cover for a vacuum cleaner. The flasks are set on the patterns and sand is sifted in by hand to fill all the crevices evenly, over the face of the pattern, then tucked after which the mold is shoveled full of sand. An extnesion frame is used to bring the tops of the two flasks on the cope mold, shown at the right to the same height. After bottom boards are placed on, a yoke is secured above each flask and the whole is turned over with a lever and squeezed. The yoke is then detached and the head containing the patterns is raised, leaving the two flasks on arms of the machine which are swung out to enable the molder to finish the mold as is shown in Fig. 5. The molder working on the cope closes it on the drag and removes the snap flask. The other molder carries the finished flask to the floor and puts on a jacket.

Oil-Burning Furnaces

Metal is supplied to the molders continuously from the melting department in the center of the shop. This is equipped with two revolving type, oil-burning furnaces with a capacity of 300 to 325 pounds each; also 5 tilting type crucible furnaces, two of which hold No. 275, two No. 125 and one No. 60 crucibles. These also are of the oil-burning type. All the furnaces were supplied by the Monarch Engineering & Mfg. Co., Baltimore. A section of the furnace department is shown in Fig. 4. The stand for the indicating pyrometer instrument may be seen at *A*, and the couple with the wire attached may be noted lying on the stand. This is used to determine the temperature of every heat while still in the crucible. A second reading is made after the metal has been poured from the furnace crucible into the pouring crucible. Besides the crucibles, hand ladles also are used for pouring.

Brass is melted in a department adjoining the aluminum melting section. This consists of 12 pits, ten of which hold No. 50 crucibles and two No. 35 crucibles.

The core department is located along one side of the foundry. This is equipped with four, coke-fired ovens filled with racks to which the cores are carried on trays after the oven has been unloaded. Much of the old sand is reused, about 75 per cent of the mixture consisting of old sand. Many of the cores are blacked to give the casting a smooth finish. Also molds are dried for this same purpose, but this is done less frequently than formerly as it has been found the castings come with a smooth finish when a parting is used.

As has been noted, castings are taken to the end of the shop to have the cores knocked out. They then are carried to the basement in trucks on an elevator and cleaned. The cleaning room is equipped with a sand-blast cabinet built by the J. W. Paxson Co. and a sand-blast table supplied by the Pangborn Corp., Hagerstown, Md. All castings having dry-sand cores are sand blasted. The gates are cut off on three band saws, and five double-wheel grinders and a number of air chippers serve to snag the castings.

Going from a consideration of the cleaning room of the sand-casting foundry to a description of the die-casting shop offers a marked contrast, as the die casting needs no cleaning unless trimming the flash or fin of the casting might come under the head of cleaning. Such castings are made by pressing molten metal into a steel die made of several parts, either by air or by hydraulic pressure, or by a type of pump operated by a hand lever. Then after the metal is forced into the mold it begins to solidify immediately and the sprue must be cut off and the end stopped to prevent any of the metal from rebounding from the mold before it sets. As soon as the metal sets the casting must be pushed from the die which is opened in the meantime. All this is a matter of seconds and each move must be made with precision.

Possibly a description of one of the dies used by the Light company will give a clearer idea of the operation. Figs. 6 to 9 show different views of a die for a beveled pinion made in two halves. This casting is designed in such a way that the two sections fit together accurately and portions of each piece overlap the other piece so that when placed on a shaft and connected with a pin the two pieces are permanently joined. Thus every time the mold is closed, metal introduced and the mold again opened, two castings, true to a guaranteed size and needing no machining, are formed. In fact, all castings are made so that no machining is required except that small inside threads must be tapped when specified. Outside threads are almost invariably cast in by the die. Besides inserts are often cast into the casting being covered entirely by the die except at such places where it is desired to cast the metal around the insert.

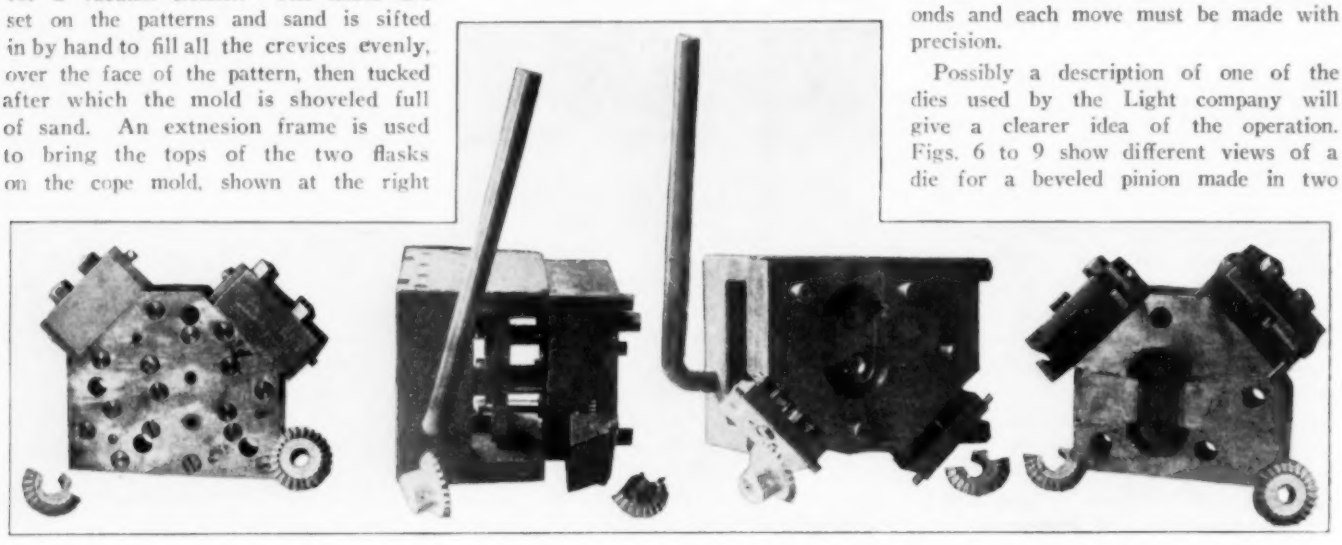


FIG. 6—REAR VIEW OF THE COVER HALF OF THE DIE FIG. 7—SIDE VIEW OF THE EJECTOR DIE FIG. 8—FRONT VIEW OF THE EJECTOR DIE—NOTE THE SECTIONS FOR AUTOMATICALLY WITHDRAWING THE LOOSE PIECES SHOWN BELOW FIG. 9—COVER HALF OF THE DIE SHOWING THE IMPRESSION

Guarantee Accuracy

The guaranteed maximum variation from drawing size is usually 0.001 inch per inch although in some cases a guaranteed variation of not more than 0.0005 inch per inch is asked. The limit depends on the shape of the casting as well as on the alloy from which it is

FIG. 10—CASTINGS ARE TRIMMED IN FOOT PRESSES USING DIES

made, aluminum alloys requiring the widest limits, while tin alloys are the easiest to make to size.

Different grades of steel are used for the dies, also depending on the shape of the die and the metal to be cast. Alloy steel with 0.5 to 0.7 per cent carbon is used for the heavier pieces and for dies for the lower melting point alloys, while for smaller pieces and for dies for the alloys with higher melting points either an alloy steel with 0.70 to 0.90 per cent carbon, or a chrome-vanadium steel, is used. All grades of steel are heat treated by quenching and tempering.

Two views of the ejector half of the die are shown in Figs. 7 and 8 and of the cover half in Figs. 6 and 9. The two loose sections or heads which may be seen at the lower corners of the ejector die, Fig. 8, form two holes in each casting. When the die is open these heads are held away from the main section of the ejector die by springs. When the die is being closed, pins on the heads slide into guide slots on the cover die thus forcing the heads toward the main section, and carrying into position the pins for forming the holes. One of the guide slots in the cover die may be seen in Fig. 9.

The great number of screws in the back of the cover die, Fig. 6, are used to hold together the different pieces of steel which go to make this section. The four larger holes in the die are guide pin holes causing the two parts of the die to fit accurately when the die is closed. The two smaller holes are gates through which the metal is introduced into the mold. A side view of the ejector half of the die, Fig. 7, shows the plate which is firmly connected to the face of the die impression with a number of small round rods. Then when the plate is moved, by a hand lever, toward the front of the die, the rods act as ejectors to push the casting out of the impression. The air vents cannot be seen on any of the illustrations. These usually are on the face of the die and must be so fine that the molten metal will not be forced through them readily. A thickness of from 0.005 to 0.025 inch is usually the limit for these vents. However, even this thickness does not prevent a fine flash of metal around the casting at the parting of the dies.

Metal is forced into the die at a pressure of from 300 to 400 pounds per square inch. So rapid is the operation that from 1000 to 3000 casts are made from a die in a day of 8 hours.

The castings are taken from the machine by the operator and placed into trays and are carried to the trimming department where they are put through a trimming dies used in connection with both foot and power presses. Fig. 10 illustrates one of these presses. The casting is laid on the lower die and when the operator presses a foot lever the upper die comes down and shears off the metal.

All the standard die-casting alloys are used by the Light company. Those with a tin base are cast into bearings and castings to be used in containers for food products. Lead castings are of advantage where acid resisting properties are demanded, and aluminum alloys where weight is a consideration and for casting required to hold a polish. For general utility, the zinc-base alloy is most frequently used. This is the strongest of the several classes of alloys, some of the zinc-aluminum alloys having a tensile strength of nearly 40,000 pounds per square inch. At the bottom of the list for strength are the tin-base alloys which seldom have a tensile strength of more than 10,000 pounds per square inch.

Book Review

The Welding Encylopedia, second edition; edited by L. B. Mackenzie and H. S. Card; flexible imitation leather, gilt edges; 388 pages with 550 illustrations; published by the Welding Engineer Publishing Co., 608 South Dearborn Street, Chicago and for sale by THE FOUNDRY for $5.00 net.

A reference book on the theory, practise and application of the four autogenous welding processes. The first half of the book is a dictionary of all words, terms and trade names used in the welding industry and also includes instructions for welding operations on the most common types of repair and production work. This is followed by description of the modern methods of testing welds, specifications for welding rods and wires for all classes of work and description of the application of welding to the various industries, automobile repairing, refrigerating machinery, structural steel, etc.

This section is followed by individual chapters on oxyacetylene welding, electric arc welding, electric resistance welding and Thermit welding. In addition to a description of each of the processes, general and special instructions are given for the application of each process. Individual chapters are devoted to boiler welding, tank welding, pipe welding and rail point welding.

A third section covers the rules and regulations enforced by federal and state authorities and insurance companies on the construction, installation and operation of welding equipment. A special chapter treats of heat treatment of steel. A collection of charts and tables shows how to prepare joints for welding, gives information on the characteristics of the common metals, shows a temperature color chart and a second color chart explaining the proper adjustment of the oxyacetylene flame. A catalog at the back of the book describes standard lines of welding equipment.

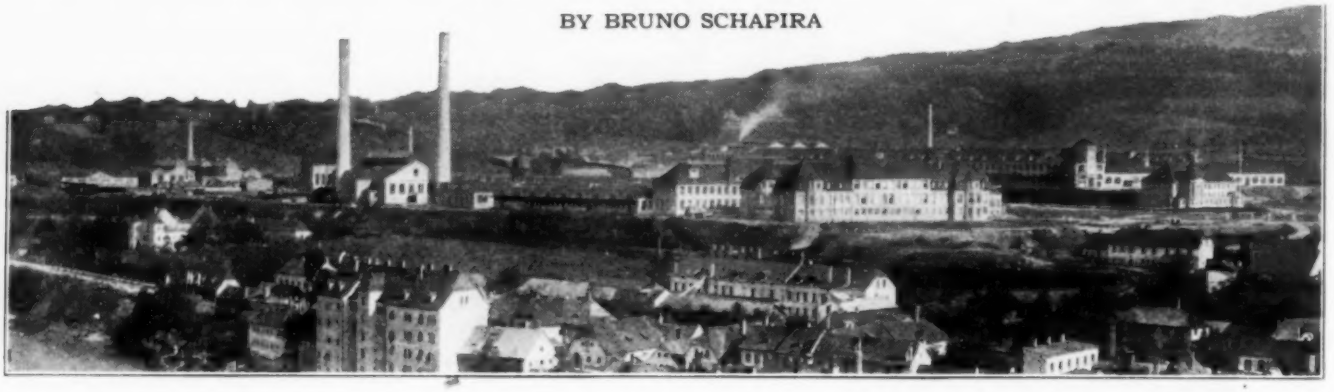
Opens Branch Offices

The Brown Instrument Co., Philadelphia, on Sept. 1, opened a branch office for the Southern district at 619 Brown-Marx building, Birmingham, and a New England branch at 185 Devonshire St., Boston.

The Buckeye Products Co., Cincinnati recently has opened a distributing depot at 218-220 N. Clinton street, Chicago in charge of R. M. Gleason.

Modern Foundries of Central Europe--I

BY BRUNO SCHAPIRA



FOUNDRIES of central Europe are subject both in the technical and business spheres to the influence of the German foundry industry. They procure their equipment mainly from Germany and on the commercial side the German foundries are powerful competitors. But since the German foundries and foundry-equipment builders are attentively watching the technical progress of the American foundry industry and are trying to accommodate themselves to its methods, Central Europe is rather frequently found to make use of technical procedure which has been established under the direct or indirect influence of America. Thus both in Austria and Hungary, to quote but one example, chill castings have been made by the Griffin process for over 25 years, railway car wheels being the principal product. Some of the appliances used are American in design and the greater part of them were obtained from America.

The technical side of the foundry art in Central Europe likewise has been influenced by the extraordinary difficult economic circumstances which have prevailed since the war, and great efforts are being made to save labor, Central Europe being short of man power. This is leading to the establishment of Taylor's methods of scientific management. Efforts also are being made to bring about a better understanding between the engineering department and the foundry so that both money and labor may be saved. Furthermore foundry production is being standardized and as a result the amount of equipment re-

The author is Central European correspondent for THE FOUNDRY.

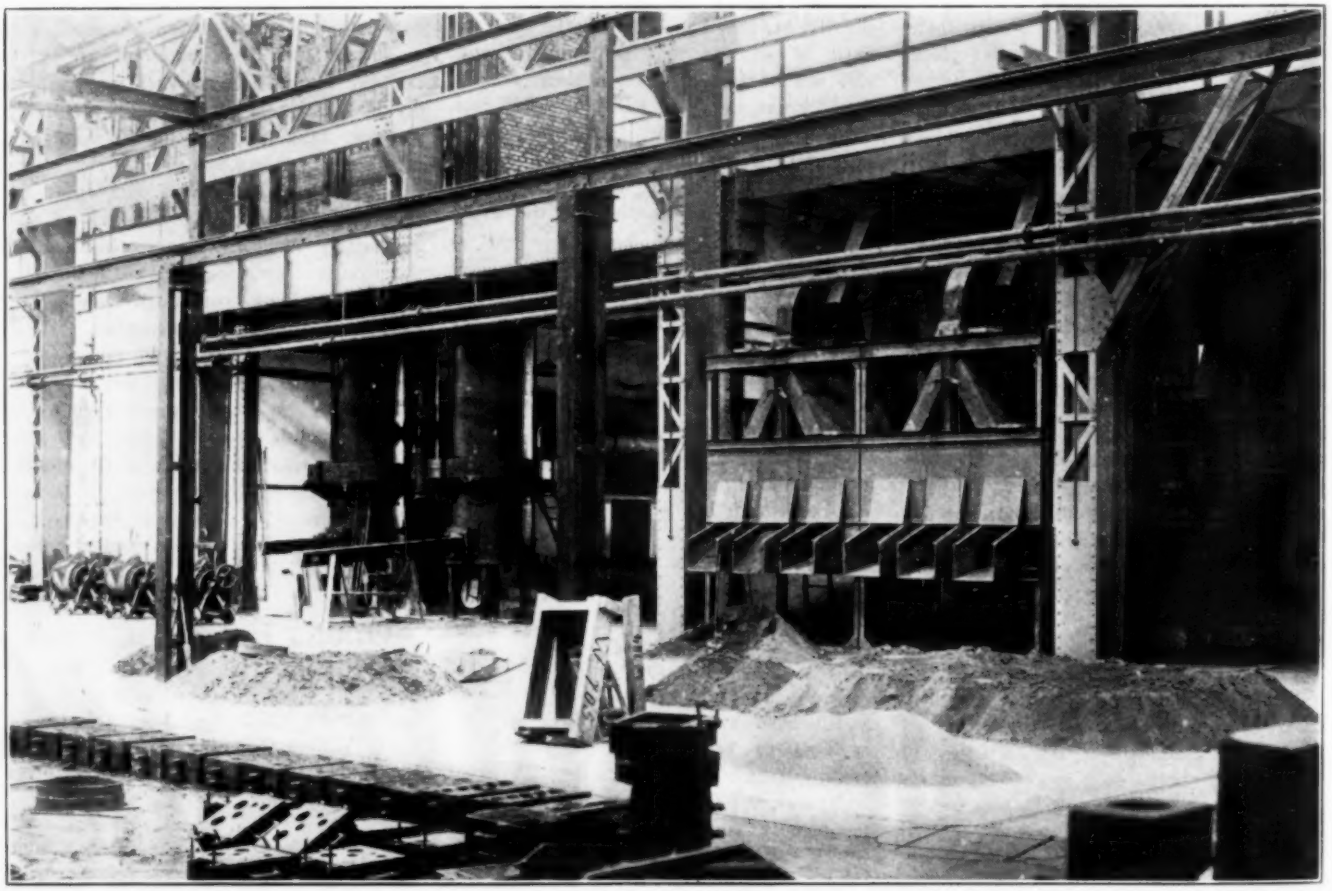


FIG. 1—THE CUPOLAS ARE FLANKED BY AN AUTOMATIC SAND PREPARING PLANT AT THE FOUNDRY IN STEYR—NOTE THE COMBINATION CAR AND CRANE TYPE LADLES AT THE LEFT

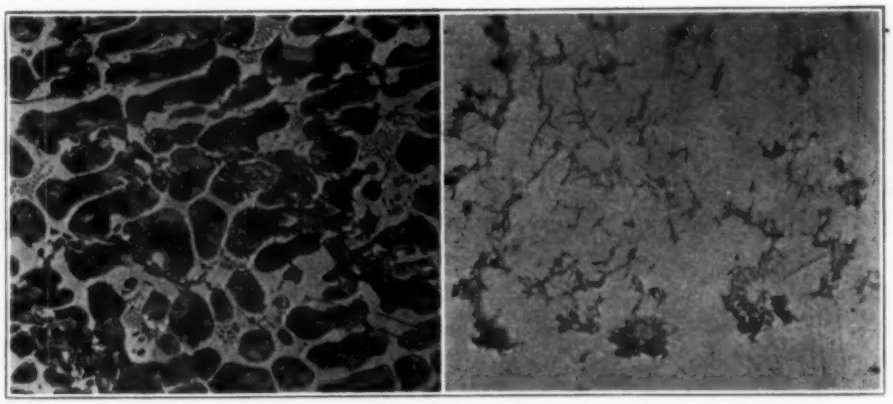


FIG. 2—MALLEABLE IRON FROM THE ELECTRIC FURNACE, NOT TREATED FIG. 3—ANNEALED MALLEABLE CASTING

quired is being reduced. This applies especially to such items as flasks.

Constantly increasing attention is being given to the questions of chemical analysis and cupola burdening, on account of the bad quality of the raw material. Chemical analyses and the scientific control of melting have made it possible to keep some Central European foundries in operation without the use of pig iron. In many cases the necessity has arisen to work up large quantities of scrap produced by other works, although this practice makes the production of first class castings difficult, as it is almost impossible to obtain an average analysis of such scrap and consequently to mix properly. To reduce the number of spoiled castings to a minimum, it has appeared desirable, as far as possible, to use only the shop's own scrap and to store the scrap of different compositions separately. Further, the number of mixtures used is being limited.

To obtain close-grained castings, pig iron containing 4 per cent manganese is added to the mixture in many of the Central European foundries. Moreover, as the percentage of silicon contained in the available pig iron is too low, ferrosilicon must be added. This is surrounded by cement to retard oxidation. The manganese loss amounts to from 25 to 30 per cent and that of silicon from 5 to 20 per cent.

The coke which the foundries are now getting contains a high percentage of sulphur, part of which passes into the iron. This circumstance, coupled with excessive amount of sulphur contained in the scrap used, necessitates the use of desulphurizing processes. The desulphurizing is performed either in the ladle after the slag has been removed or in a receiver placed in front of the cupola, the result being the elimination of the sulphur contained up to a maximum of 50 per cent of the amount originally present.

Experience during the war showed that bessemer steel can be produced from a raw material which is almost

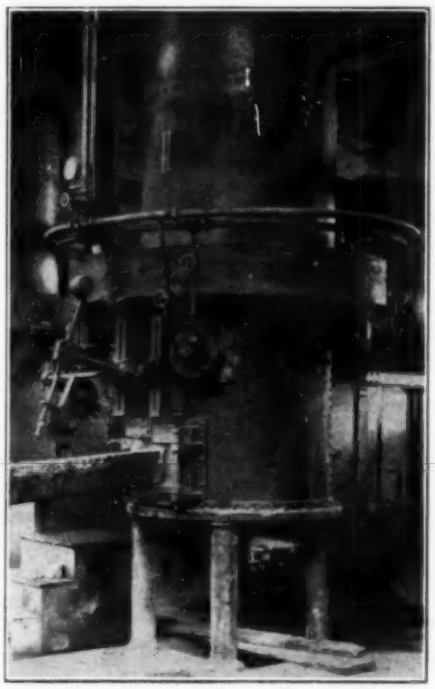


FIG. 4—CUPOLA WITH AUXILIARY OIL-FIRING EQUIPMENT AT THE AUTOMOBILE FOUNDRY IN STEYR

exclusively scrap. In Central Europe the scrap is mixed with coke from which it absorbs carbon for the recarburizing process. The silicon required for producing a high temperature is mixed in the converter in the shape of ferrosilicon, at the beginning of the blow.

Central European cupolas usually have less diameter and greater height than in America. The customary section is from 186 to 310 square inches for one ton production per hour. The normal period of working amounts on an average to eight hours. The blast volume required is about 6.5 cubic meters of air at 0 degrees Cent. for one kilogram of coke. This is 229.4 cubic feet of air for 2.2 pounds of coke or 105.0 cubic feet per pound of coke. The ratio of coke to iron except in the bed, is not usually below 12 to 1 and rises up to 6 to 1 if hot iron for thin walled castings is required. If the coke in the charges is reduced, then the quantity of bed coke must be correspondingly increased. Nor is it advisable to economize excessively in the use of coke with the inferior raw materials now available in Central Europe as the quality of the molten iron is usually impaired by such practice. A favorite way of controlling the working of the cupola is by gas analysis.

Various experiments have been made with regard to waste-heat utilization but without result. In some cases coke firing is supplemented by oil firing, the oil being blown over the tuyeres into the melting zone. In this way the consumption of coke may be reduced by 60 per cent. Fig. 4 illustrates a cupola furnace of this kind, with combined coke and oil firing, erected in Steyr.

Great difficulties are caused by the inferior quality of the coke. Considerable 24-hour coke is being made. It is soft and porous, breaks up easily and is high in ash.

During the war many charges con-

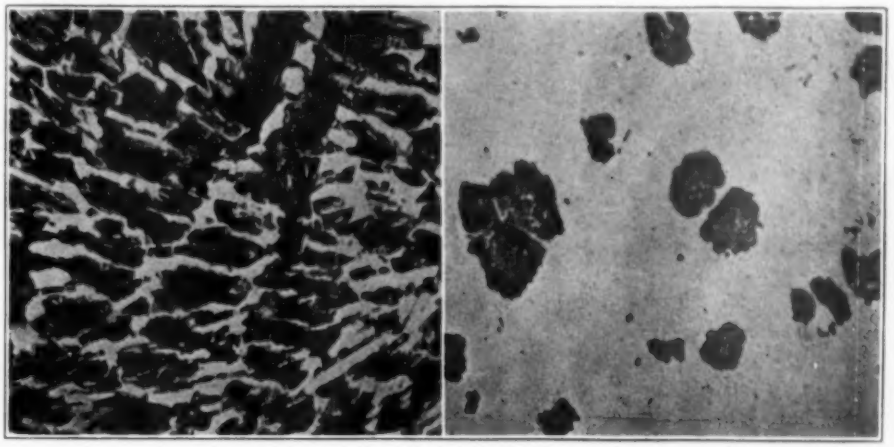


FIG. 5—CUPOLA MALLEABLE BEFORE ANNEALING FIG. 6—MALLEABLE IRON FROM THE CUPOLA AFTER ANNEALING

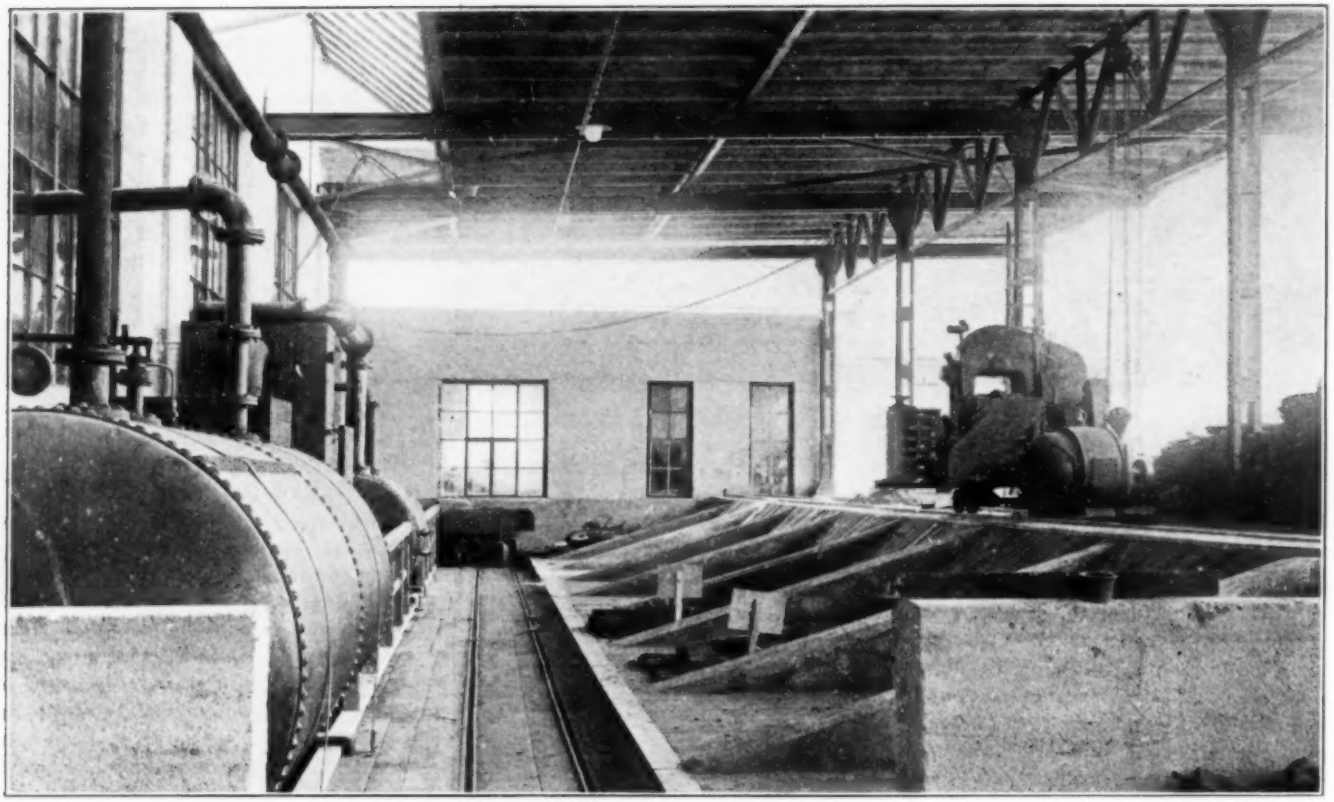


FIG. 7—RAW MATERIAL STORAGE WITH SPECIAL ELECTRICALLY OPERATED PIG BREAKING MACHINE ON THE TRACK ABOVE THE BINS

sisting only of scrap were melted in open-hearth furnaces. To introduce carbon into the bath, retort-coal was used, mixed with the scrap. Attempts to replace the coal by coke in the open-hearth furnace failed, as a certain limit of temperature cannot be surpassed. On the other hand, heating by means of gas containing a high percentage of heavy hydrocarbons or hydrogen gas has proved to be successful. Experiments have tended to show that the open-hearth furnace operates most economically when a gas containing a high percentage of carbonic oxide (CO) is used in melting down whereas a gas with a small percentage of carbonic oxide and a high percentage of heavy hydrocarbons is more suitable for finishing, and fresh endeavors are being made to construct producers which will come up to these demands.

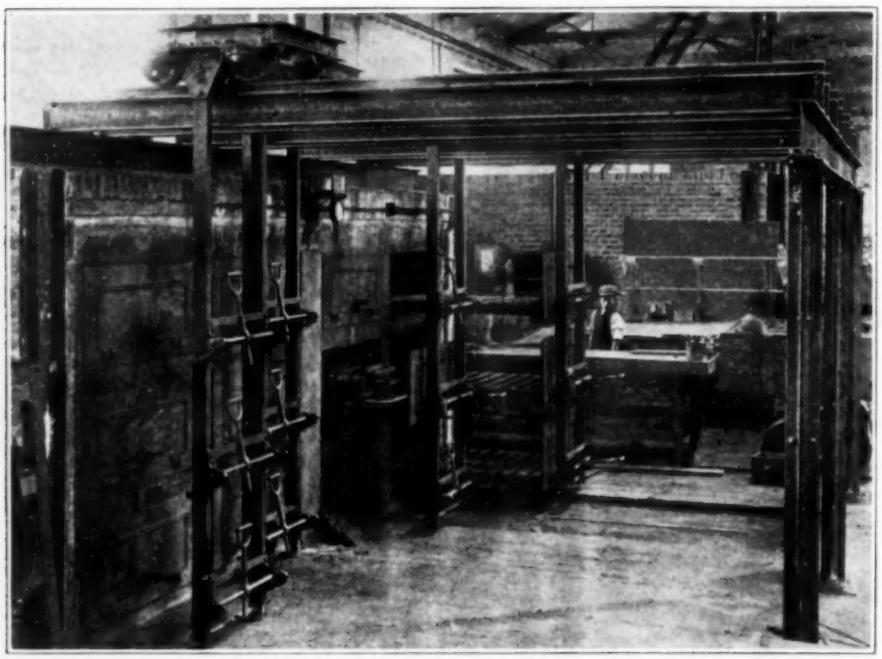


FIG. 8—ELECTRICALLY HEATED CORE DRYING OVENS IN THE AUTOMOTIVE FOUNDRY IN STEYR

For producing steel castings of special softness, and thinly liquid, a small open-hearth furnace has been developed designed for a charge of 2 metric tons. It is charged mainly with wrought iron and mild steel scrap. The charge chiefly employed consists of 75 per cent scrap, 20 per cent pig iron and the customary admixtures. Temperatures up to 2000 degrees Cent. are obtained with this furnace.

In small converter works it has been found that charges containing manganese up to 1.5 per cent and a small percentage of silicon turn out to have the smallest amount of iron in the slag. Therefore, the iron losses experienced up to now in some small converter plants may be traced back to strong blast currents and to a lack of manganese in the charges.

The use of electric furnaces for producing steel castings is extending in Central Europe. As the charge is not exposed to unforeseen influences, a material of great purity can be obtained which is particularly suitable for castings free from blow holes. The sulphur and the phosphorus can be almost altogether eliminated. Castings with thin walls can be obtained, as temperatures of any degree can be produced. Installations where the electric furnace is used for producing

synthetic cast iron made of a mixture of cast and wrought iron scrap as in France, are rather rare. The furnaces almost exclusively are of the arc type such as the Stassano tilting furnace installed in the Gasser works in St. Poelten. Figs. 2 and 3 show sections of a malleable iron produced in this furnace, magnified 100 diameters, Fig. 2 illustrating the casting in the crude state and Fig. 3 in the annealed state. The charge consisted of 50 per cent scrap and 50 per cent iron from the cupola. Carbonization up to 3 per cent carbon was effected by means of coke. Figs 5 and 6, on the contrary, represent cupola-furnace malleable iron in the crude and in the annealed state.

The importance of having the molding sand properly prepared has come to be more and more regarded, so that nowadays great attention is given to sand treatment in Central European foundries. According to the nature and quality of sand desired, the raw sand is dried in drying stoves or furnaces, then crushed and mixed with the old molding sand which has been cleaned magnetically of iron and other foreign

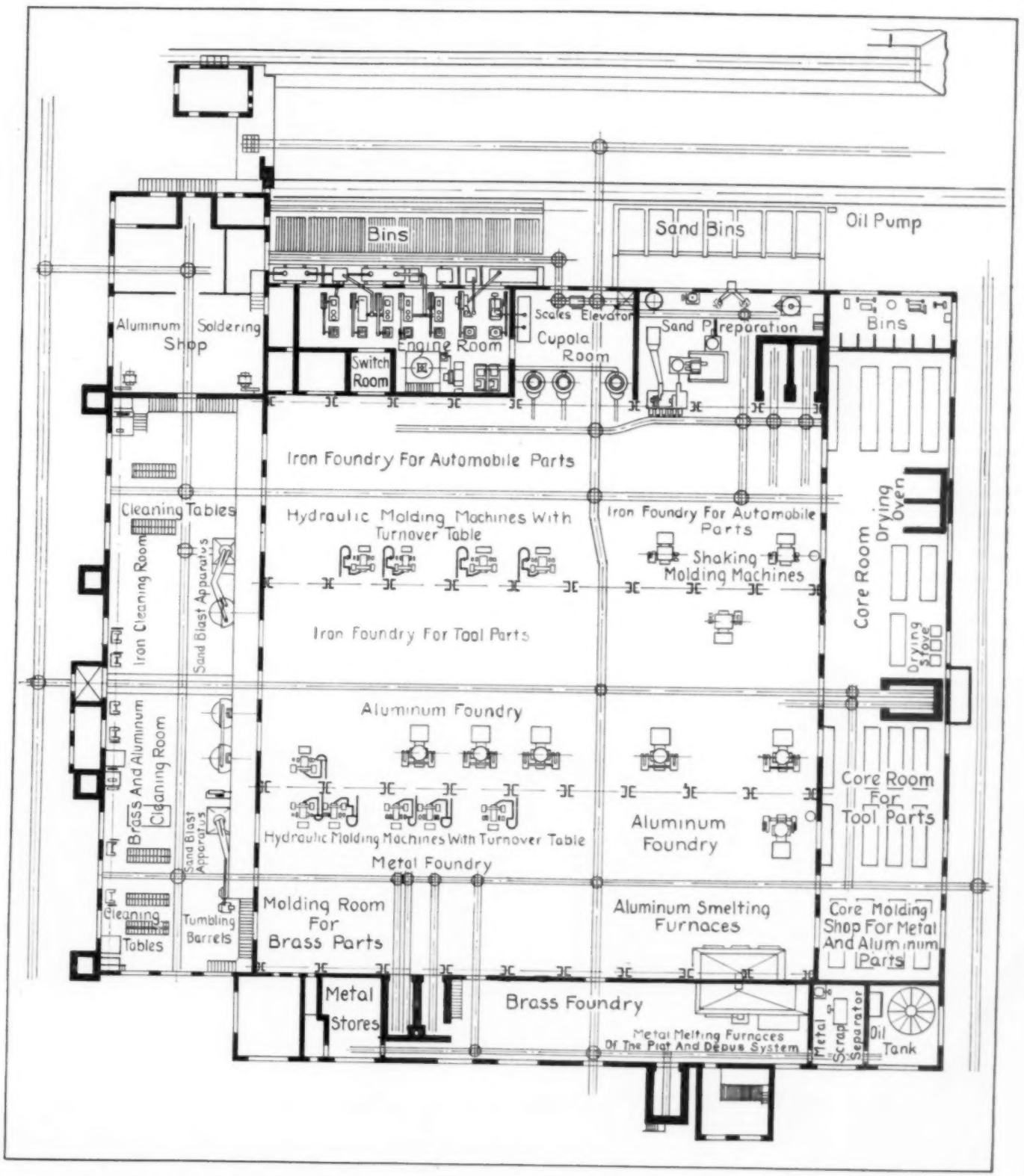


FIG. 9—ARRANGEMENT AND EQUIPMENT OF THE CASTINGS DEPARTMENT OF THE AUTOMOBILE WORKS SHOWN IN FIG. 10

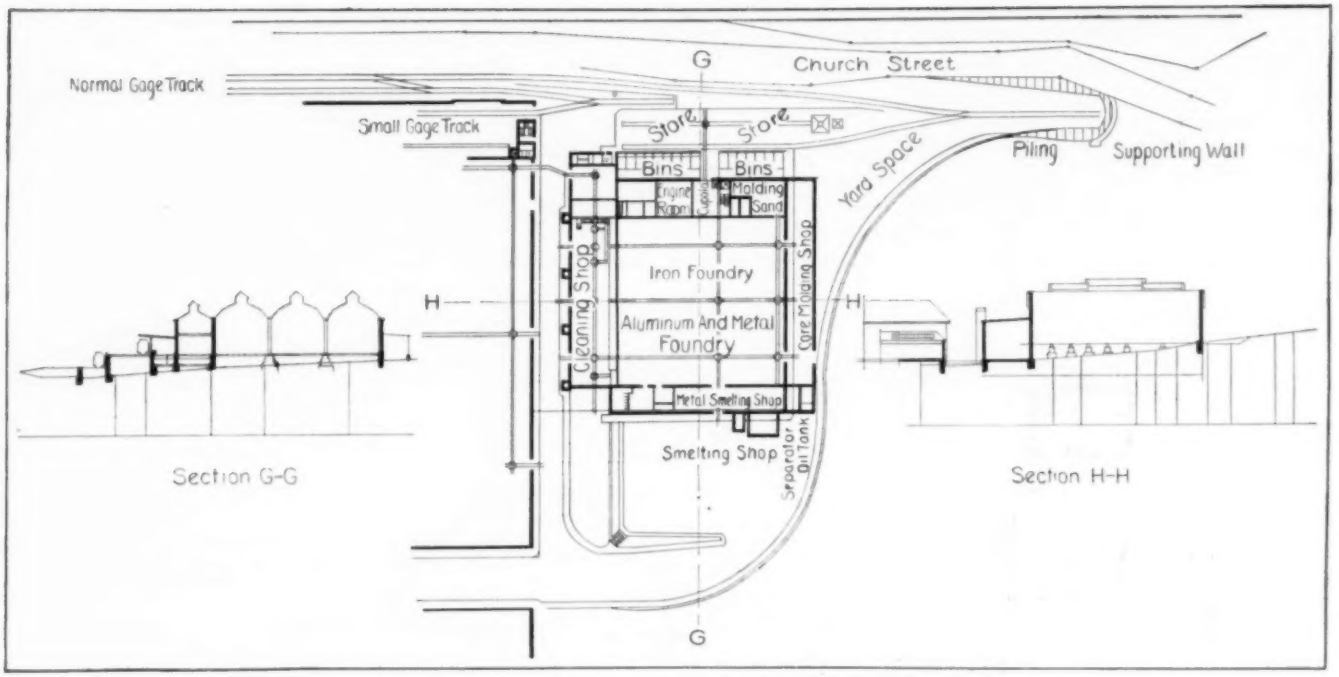


FIG. 10—GENERAL PLAN OF THE AUTOMOBILE FACTORY IN STEYR

substances. In the mixer a certain percentage of coal dust and moisture is added and the mixture is then transferred to the disintegrator. Fig. 1 illustrates the automatic sand treating plant in the automobile foundry in Steyr, Austria.

In the development of molding machines American influence makes itself felt distinctly. Hand-ram machines are given preference for castings of small or medium size, provided their number is not too great or the shape too intricate. Hydraulic machines are popular in Central Europe

The Bonvillain-Ronceray system, which uses hydraulic power and embodies a special method of making the pattern plates is widely used. The cost of the pattern plates is such that machine molding is profitable, as compared to hand molding, on orders for as few as 50 to 100 castings. For patterns of deep draw, jar-ramming machines driven by compressed air are being given increasing preference. Fig. 12, which appears in the next installment of this article shows part of the molding machines in the foundry of the Leobersdorfer engine factory, where large castings such as water turbines, rotors, etc., are molded. Recently this foundry has taken up the use of permanent iron molds.

The mold-drying or core ovens in Central Europe are heated by electricity in several districts. The air is sucked in by a ventilator, and led along the electric heating elements which give it a temperature of about 400 degrees Cent. Fig. 8 illustrates an electrically-heated drying oven in Steyr. Drying ovens also are designed to use a combination of gas and electricity; in this case the air for combustion is preheated in a recuperator. Sheet steel ovens of large size also are constructed in such a way that the waste heat of one chamber serves for preheating an adjoining one, uninterrupted operation being rendered possible in this way.

The sand-blast is widely used for cleaning castings. The automatic cabinet or tumbling-barrel type of machine is used for small castings. Castings of medium size are cleaned on turntable machines, while large castings are cleaned in sand-blast rooms with free sand jets.

Typical Central European Foundries

In the spring of 1922 the author visited a number of iron and steel foundries in Central Europe and the results of this trip are embodied in the following description. To give the reader as comprehensive an idea as possible of the shops in this part of the world, a combined malleable iron and steel castings foundry, an exclusive steel foundry, a gray-iron foundry connected with a large automobile plant and two engineering foundries will be described; the latter two making castings up to the largest size.

The first foundry which will be described briefly is that of the Oesterreichische Waffenfabriksgesellschaft (Austrian Weapon Mfg. Co.). It was founded in 1867 and until the autumn of 1918 was engaged exclusively in the manufacture of arms. Since that time it has been necessary to change over the works to the production of motor cars, bicycles, shotguns for hunting, ball bearings and storage batteries. The factory now belongs to the biggest motor car manufacturing concern in Central Europe. It employs 7500 men in Steyr, and 2000 additional workers in a steelworks in Styria and in a factory in Vienna.

The illustration at the head of this article gives a general view of the works and surroundings. It covers an area of more than 240 acres. A remarkable feature is the big erecting shop for motor cars which covers an area of 54,000 square yards.

Construction of this foundry was commenced during the war and finished by the middle of 1920. Recently, the plant was further extended and a large battery of jar-ram molding machines was installed. The foundry, the situation of which will be seen from Fig. 10, is located somewhat unfavorably from the standpoint of the transportation of the raw material coming from the railway. The foundry is situated about 15 feet higher than the rest of the buildings and the tracks on which the raw materials are brought in had to be laid partly with a gradient of 3.33 feet rise in 100 feet and partly with a gradient of 1.6 feet in 100 feet. However, the part of the track in front of the storage bins is level. The cleaning room from which the finished castings are taken to the machine shops is on the same level with the rest of the buildings belonging to the plant. As will be seen from Fig. 9, the foundry consists of three large bays with an additional bay for

the melting plant. The sand preparation department and engine house adjoin on one side, while the nonferrous metal foundry is located in a wing on the other side.

The gray iron foundry has a capacity of 20 tons per day, the aluminum foundry two tons per day, while the other nonferrous departments have an output of 1½ tons a day. One-half of the foundry is devoted exclusively to the production of gray iron castings, the other being devoted to nonferrous metal castings.

The two sections are separated from each other as regards their raw material. These materials are stored in special bins, set aside for coke, sand, pig iron, etc. The materials are delivered over a track of normal gage from the north side of the foundry as shown in Fig. 10. The pig iron is broken by an electric pig breaker. The sand is dropped into the bins, from which it is elevated to the automatic sand dressing plant shown in Fig. 1. The sand preparing plant has a capacity of 6.5 cubic yards per hour. It consists of two drying stoves, ball and crushing mills and mixing apparatus. The prepared sand falls into the bins shown in Fig. 1, from which it is transported to the molding floors by an electric trolley system. The sand destined for coremaking is treated in a special sand plant located in a wing of the core shop.

The broken pig iron is lifted by an elevator up to the charging platform where the charges are made up according to analysis in what is called the *burden room*. The iron is melted in one of three cupolas, the hourly melting capacity of each of which is 4.4 tons. One of the cupolas is equipped with an auxiliary oil-firing device shown on Fig. 4. It is said this arrangement saves a large amount of coke.

The most important castings are the cylinders for motor-cars with 4 and 6-cylinder engines, together with other parts for motor cars. The cylinders are molded on jar-ramming machines worked by compressed air. The machines have a table size of 5 x 5 feet. The finished molds are dried in two drying ovens partly with gas and partly with coke.

The cores are made in a separate shop in which two electrically heated core ovens containing sliding racks are provided as shown in Fig. 8. The daily output amounts to about twenty 6-cylinder units and ten 4-cylinder units. The remainder of the automobile parts are molded on hydraulic molding machines with rollover tables and also on stripping-plate molding machines. Gray-iron pistons and crank cases are molded on jar-ramming machines.

The electromagnetic dressing plant, the exterior of which is illustrated in Fig. 11, has been provided for reclaiming the waste iron in the sweepings and old molding sand. The reclaimed iron is taken back to the scrap bins and the old sand which no longer can be used is carried away in wagons.

Another part of the foundry, as shown in Fig. 9, is used for the production of nonferrous metal castings. Three oil-fired non-crucible furnaces are provided for melting aluminum, with alloy metals. Two have a capacity of 1320 pounds and the third 330 pounds. The oil is stored outside the foundry in a tank holding 15,000 gallons. The oil flows to the burners by gravity. The larger nonferrous castings are molded on jar-ramming machines with table dimensions of 5 x 5 feet and 4 x 4 feet. The cores to match are produced on jar-ramming machines with tables 2 x 2 feet. The smaller aluminum castings are molded on hydraulic molding machines with rollover tables.

Bronze, brass and special alloys are melted in five furnaces. Two furnaces are used to melt up the waste metal and impure scrap material. All these furnaces are coke fired.

The castings are conveyed to the cleaning room, which is on the second floor, by cranes. The cleaning department is equipped in an up-to-date manner with pneumatic tools, tumbling mills, sand-blast apparatus, dust removing appliances, etc. Before leaving the cleaning room the castings are tested as to their cleanness and accuracy. They then are transferred to the stores department.

(Concluded on Page 908)

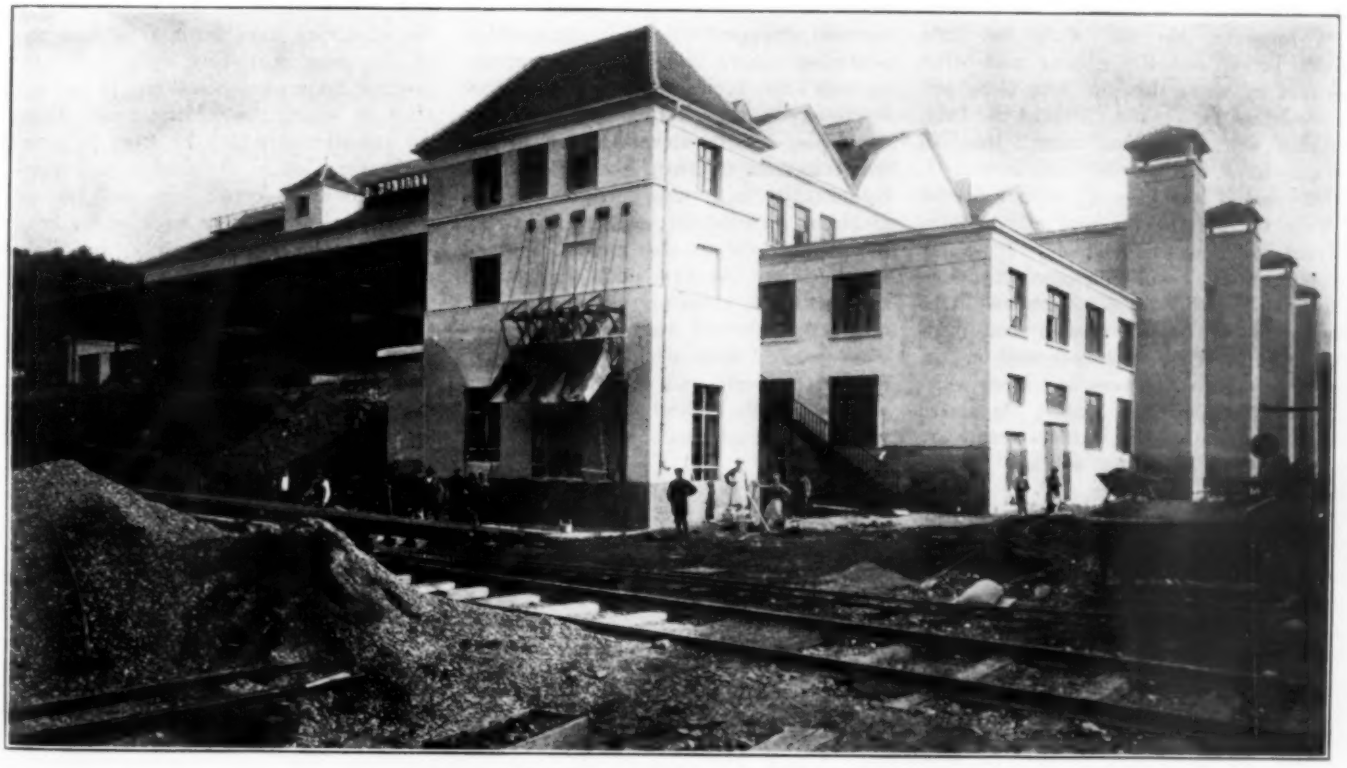
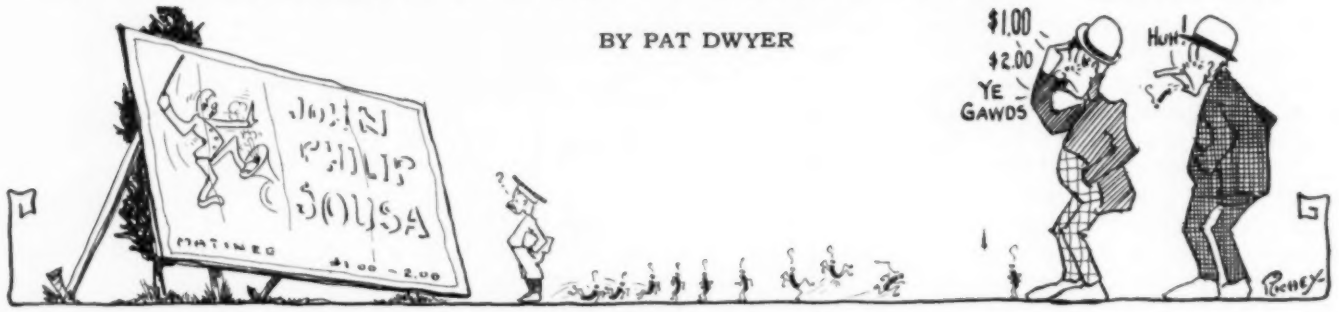


FIG. 11—ELECTROMAGNETIC TREATING PLANT FOR USED SAND

Bill Renews His Youth with Music

BY PAT DWYER



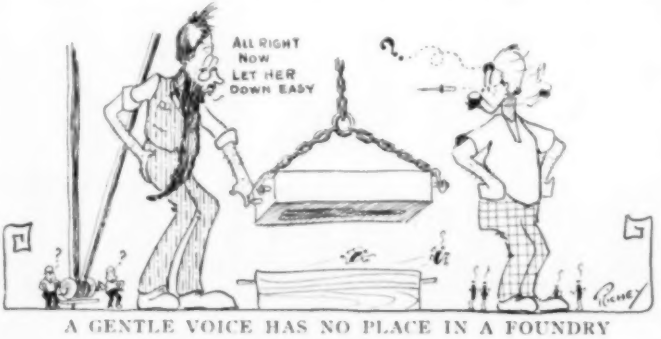
FLARING posters on every billboard and display ads in all the daily and Sunday newspapers had directed attention for some time to the fact that on a certain date John Philip Sousa and his famous band of 100 pieces—100—count 'em—were going to park in our midst for a limited number of engagements to give the inhabitants a real treat. I have heard the band on various occasions. Probably, you also have had a similar experience so I need not dwell on the performance which *herself* and myself in company with Bill and Mrs. Bill attended one night. I like John and I like his band, whether in person or on a phonograph record. I can remember, when I was many years younger than I am now and played a modest part in the Silver Cornet band in the old home town, that my favorite numbers were those written by the famous march king.

On this recent occasion I was somewhat shocked to find that he had discarded the military whiskers, but on the other hand I was pleased to note that this was the only concession he had made to modern progress. He still wore the little short jacket and the glasses and—what pleased me more than anything else—was to find that he has not curtailed his long, flowing and euphonious name. John P. would have been a desecration and J. Philip would have been a criminal discord crying to high heaven and all the nine Muses for vengeance; while J. P. simply is out of the running altogether. Such barbarous combinations possibly might be appropriate in connection with some modern noise perpetrators who depend on cow bells, moaning saxophones and freak whistles for their offenses against the sacred name of music. Abbreviations simply are unthinkable when applied to the creator of *El Capitan, The Bride Elect, King Cotton, The Stars and Stripes Forever,* and scores of other inspired melodies that have heartened lagging feet and quickened the pulse beat of marching men for several generations. The first time I saw and heard John Philip and his band was during the third year of my apprenticeship in the foundry. I had been advanced to the position of assistant to one of the leading molders and rapidly was approaching the point where I resented my mentor's action in feeling over a surface after I had finished it or his totally unwarranted impudence in trying bolts and chaplets I had fastened with a view of assuring himself that I had secured them properly. If you are a young reader you will appreciate my state of mind and if you are as old as I am now, you probably will laugh and recall how silly you were yourself in your young days.

On the day the band arrived in town we had closed a dry sand job, a mortar box for a gold crusher, by noon and to fill in the time before the wind went on, the old man had given each of us a small pattern to make one off. Mine was a wheel for a wheelbarrow with the long hubs, arms and rim cast as a unit. The mortar box was cast early in the heat to afford us an opportunity of feeding it for about an hour and as a result I did not get iron to pour my wheel until a few minutes before the bottom dropped. I had engaged a charming young damsel to accompany me to the concert, cheerfully had squandered the equivalent of four days' pay for the tickets and naturally was anxious to rush home, don the boiled shirt and other insignia of the carefree man about town. I carried the ladle back to the cupola, hurried to the floor, knocked off the clamps and without thinking of the consequence, threw off the cope and then was horrified to find that the iron had not set properly and the hub had been pulled off the wheel. The old man saw it about as soon as I did. I have been on the receiving end of the battery many times since, but believe me, Marmaduke, I never have experienced anything to equal the speed, control and venomous intensity of the line of talk the old boy threw into me on that occasion.

The gaffer was a highly skilled old foundryman. Even in my young days I held him in respect and now that I look back in the light of broader experience and consider the manner in which he handled the work with the available rigging, I realize that he was even a better man than I gave him credit for at the time. However, he had his peculiarities and for that matter, so had several other members of the shop's crew. I have not seen any of them for many years, but owing I suppose to that peculiar mental phenomenon known among the elect as association of ideas, Sousa and his band recalled them to mind as vividly as if I only had left the shop yesterday.

The old fellow resembled the Ancient Mariner in that he was long and lean and brown and also was equipped with the glittering eye; in fact he had two of the most glittering eyes that ever saw an apprentice sneaking in or out, after or before the whistle blew. From the manner in which he kept in touch with every job in the shop I was minded at times to credit him with an extra pair of eyes in the back of his head. He had the edge, slightly, on Coleridge's old salt water friend in that he wore a full beard, but why he consented to carry such a brush with the implied labor of cleaning it every night was a mystery to me. Vacuum cleaners had not been invented up to that time and he probably had to depend on the hose and curry comb.



A GENTLE VOICE HAS NO PLACE IN A FOUNDRY

He lent a hand and usually assisted in setting the cores in large molds. Of course, at these times shop etiquette prescribed that he issue all orders to the craneman in lifting and lowering the cores several times until they finally were located in their proper position. Instead of signaling by hand according to modern shop practice, necessitated by the fact that the traveling

crane operator is too far away to hear verbal orders distinctly, the old man always spoke to the man or men on the hand power jib crane.

Bent half double, with both hands steadying the core, with his gaze directed to the bottom of the mold and further handicapped by a large chew of tobacco and the encircling foliage referred to in the preceding paragraph, he would remark in an easy conversational tone: "Let 'er down a little." The crane man could not distinguish the words and naturally would hesitate to move the load either up or down. Apparently addressing an imaginary craneman under the floor, our hero would repeat the order in the same tone. Still no action. Occasionally at this point one of the molders would signal with his hand and the core would descend, but more frequently they allowed nature to take its course. If the core did not move after the third mild request the old boy would straighten up and turning a face resembling that of a wild boar with the tooth ache on the luckless craneman, he would roar out a string of sizzling invectives fit to melt all the babbitt in the bearings. He always directed particular attention to the gentleman's ears and intimated that they were the only parts of his anatomy that failed to measure up to standards of his probable ancestors.

Usually the craneman was of that mild, inoffensive type, that considers a certain amount of abuse from the boss as a regular part of the day's work and though inwardly he might cherish a fond desire to take a shovel and split the old lad neatly like a herring from head to tail, still he kept his thoughts to himself and patiently resumed his work when the tirade was over. Possibly a vision of the hangman acted as a deterring factor, but in the great majority of cases I imagine that a fear of losing his job was all that kept his hands off the shovel. A notable exception to the general rule, in the person of a husky ex-lumberman, was assigned to the crane one day and when the gaffer started on his favorite indoor sport, the craneman let the load go by the run and in two jumps landed in front of the foreman. We were delighted to find that the young man was endowed with a fluent, profane and picturesque vocabulary that made the old man's line sound like a Sunday school oration. He wound up by declaring that nothing but a good and pious upbringing in which he had been taught to respect gray hairs prevented him from taking the petty tyrant apart in small sections and ramming him down the cupola as an introduction to his future home. He demanded, and received his time and incidentally the silent thanks of every man in the shop, with possibly one exception, and we had no more fireworks for many a long day.

GIVING AN EXHIBITION OF A FISH CHEWING TOBACCO

Other characters in the old shop's crew included two brothers who had worked in the same place from a time, as the the old chroniclers used to say, when the memory of man runneth not to the contrary. Each man had a hump on his back like a camel, but in the case of one the resemblance to the ship of the desert ceased at that point. I regret that my acquaintance with camels, those that come in packages, or their equally smelly prototypes who pad around on their own four feet, is limited and therefore I cannot speak authoritatively. However, we are informed by credible authorities—and I for one am willing to accept the opinion in preference to associating with one of the unsavory brutes for a week with a view of determining the point personally—that a camel can go for a week without a drink. This ancient molder could not go a day without a drink, or, what amounted to the same thing, he thought he could not and what is still more to the point he never made any attempt to try such a hazardous experiment. Invariably he was dry in the morning and if any person happened to comment on the point, he explained the condition by the statement that he had not had enough to drink the preceding night.

The brother, although resembling him physically was of a somewhat different type mentally. He had been converted —with a few mental reservations—a few years before I had the pleasure of making his acquaintance. He had given up drinking, card playing, profanity and other allied and unseemly forms of amusement, recreation and pleasure; but still clung to such mildly sinful habits as the use of tobacco both for smoking and chewing and the reading of dime novels. I was inclined to err along the same line and perhaps my opinion is biased. I have no comment to offer in connection with the dime novels, but I think he might have dispensed with the use of tobacco with pleasure and profit both to himself and to those unfortunately obliged to double up with him occasionally on the same job. He smoked with a fair degree of skill but with a totally unwarranted overhead in the shape of matches, his own and other people's—mostly other people's. In the matter of masticating tobacco, he was a lamentable, but pitifully persevering failure. In sporting parlance, he had no control. Instead of chewing diligently for a stated period and then discharging the accumulated elixir in a neat, spirited and workmanlike manner, he expectorated spasmodically. In between times the juice slowly trickled down over his vest from both corners of a pendant and tremulous lower lip.

He did not employ any of the accepted forms of profanity either as a relish to his conversation or as a safety valve under aggravating conditions. He pat-

REALISTIC CONFIRMATION OF THE OLD FOUNDRY TRADITION TO THE EFFECT THAT MOLDERS NEVER DIE

ted himself on the back, figuratively, for his strength of character in thus remaining within the letter of his resolution. However, traces of the old leaven occasionally would ferment within him and to adequately cope with these wrestlings of the spirit he had invented a series of denatured expletives which afforded him instant relief when laboring under the stress of the most intense emotion. He was endowed with the placid disposition of a well trained little red cow and was not easily riled; but in common with all those who toil in the foundry he had the usual trials and tribulations that called for vocal relief. If a cope dropped, or a casting ran out; if he poured a job short, or if a piece of pig iron fell on his toe he would sum all his outraged feelings up in one blood curdling phrase: "Set fire to it!" Occasionally he was moved to use the invocation twice, but usually one serious and heartfelt application tranquilized his spirit. On the way home from the concert I told Bill of my train of thought and asked him if he remembered this particular character. I was gratified to find that Bill's recollection was as vivid as my own.

"Remember him?" said Bill. "Oh, boy! I never take a chew of tobacco but in fancy I see the old goat with the little streamlets trickling down and impinging on his little trick vestlet. I was doubled up with him one day making a 5-foot pulley with a 12-inch face and drew a bawling out from the old man that really was undeserved, but which effectually directed my attention to one of the many pitfalls lying in wait for the unwary molder. I learned a somewhat disagreeable lesson on that job and my self-esteem was considerably below par for some time; but I have discovered later in life that bitter lessons sometimes are blessings in disguise in that they make the deepest impression and remain longest in one's mind.

"The pattern was one of the old style, made in two complete halves, split through the center line of the arms and designed to be molded one half in the cope and one half in the drag. We laid the bottom half of the pattern on the board, rammed the drag, rolled it over, made the parting, adjusted the top half of the pattern and then set on the cope. The bars were in bad shape and we had to fit in a great many chucks, particularly around the outside and inside of the rim. We used long soldiers instead of gaggers and the combination of two soldiers and a chuck near the rim at each bar left a pocket into which the sand did not ram readily. In the light of later experience I learned that these pockets must be carefully finger tucked and hand rammed, but at the time I only knew the standard foundry rule: 'Do not use the rammer too close to the pattern.' My partner apparently was no wiser than I and we rammed the cope with no particular attention to these danger pots. The cope was lifted, rolled over, the edges surrounding the pattern nailed and then after the pattern was rapped and drawn about ¼-inch, the cope was rolled back to its original position and set up on a pair of horses where the pattern was withdrawn, the mold finished and the arms and hub blacked. The trick of leaving the pattern in the cope to support the walls of the rim while the cope is rolling over was current practice in the old shop before my time, but I have been in many shops since where apparently it is unknown. Where no support is provided, sand from the upper side of the rim is liable to fall off while the cope is suspended in air during the rolling over process.

"We did not notice the soft spots on the face of the rim, but, believe me the iron found them and when the casting was shaken out it resembled one of those tractor wheels with cleats across the rim, more than a pulley. The job was in a hurry so they took the casting into the machine shop and turned the humps off both on the inside and the outside, but the foundry had to stand for the extra work and you can bet the few pointed words handed to the old man in the office were passed on to us with extemporaneous improvements."

"Do you think," I said, "that any of the old boys are alive yet?"

"No," said Bill, "I don't. There is a tradition in the foundry that molders never die and it may be that you would have trouble in finding a marble monument marking their last resting place, but I was down in that part of the country a few years ago and could not find a single one of the boys of the old brigade. They may have evaporated, or dried into a puff of dust and blown away, but the fact remained that they were gone—somewhere."

Modern Foundries of Central Europe—I

(Concluded from Page 905)

The machinery for producing the compressed air and the hydraulic pressure required for the molding machines and the cupolas is located in a room near the cupolas. For developing an air pressure of 100 pounds per square inch three compressors with a total output of 885 cubic feet per minute are used. They supply the compressed air necessary for driving the jar-ramming machines and the pneumatic rammers and chippers. To obtain compressed air with a pressure of 30 pounds per square inch for the sand blasts, four compressors with a total output of 1590 cubic feet per minute are used. The hydraulic pressure of 740 pounds per square inch for the hydraulic molding machines is developed by a hydraulic pump with an output of 52 gallons per minute. A turbo-blower supplies the blast for the cupolas, while a Roots type blower is kept on hand. Each of the blowers have an output of 3000 cubic feet per minute.

The machines in this foundry require the service of motors with an aggregate of 1200 horsepower. The power demand of the entire plant is supplied by a turbo station with a power output of 11,000 kilowatts. Moreover, a big water-power station of 45,000 horsepower is being built in the vicinity of the works and is due to be finished in the autumn of 1923.

Tests Ground Coat Enamel

Preliminary tests have been conducted by the United States bureau of standards to determine the causes of specking of ground coat enamels. This specking appears in spots of oxide and slag in the enamel coating, a condition which appears to be due to excessive local rusting of the steel previous to the firing of the enamel. The results of the tests indicate that the rusting and subsequent specking are due to an excess of acid or salts in the enamel. The defect has been remedied by the addition of sufficient sodium hydroxide to the enamel previous to the dipping operation. The investigation is to be continued.

Opens Engineering Office

Frederick Franz, for the past four years chief engineer of the Terminal Engineering Co., New York, manufacturer of trucks designed for combined indoor and outdoor service in connection with railroads, shipping and industrial plants, has established an engineering office at 27 Warren St., New York, for the purpose of solving special problems of engineering relating to labor saving machinery for industrial plants.

Sell Malleable Company

Stockholders of the Kokomo Malleable Iron Co., Kokomo, Ind., recently voted in favor of the proposed purchase of the company by a group of manufacturers, including interests owning the Kokomo Brass Works, J. W. Johnson, John P. Grace, C. F. Byrne, and George Kingsten, the latter two owners of the Kokomo Brass Works, are interested.

French Hold Sessions at Nancy

Foundry Association Directs Effort Toward Standardizing Testing—Properties of Malleable Studied—American Exchange Paper Is Received with Interest

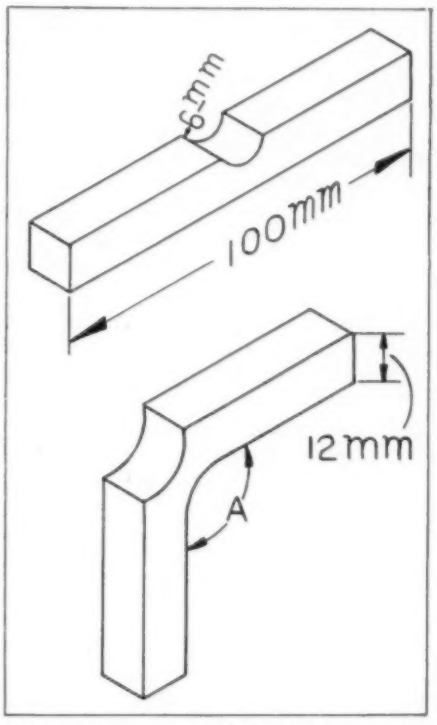
BY VINCENT DELPORT
French Correspondent of THE FOUNDRY

THE first meeting of the Association Technique de Fonderie de France, or A. T. F. as it is called, held in France in nine years took place at Nancy in the department of Meurthe et Moselle, Oct. 5-8. This organization was founded in 1909 but its activities were interrupted by the war and the last formal meeting was held in 1913. However the A. T. F. co-operated in the successful convention which was organized last year by the Association Technique de Fonderie de Liege, in Belgium, as reported in THE FOUNDRY, Nov. 1, 1921. This year's meeting was highly successful and was attended by several hundred French and Belgian foundrymen and representatives from Italy, Switzerland and Luxembourg.

The meeting also marked the inauguration, from the American side, of what it is hoped will be an annual exchange of courtesies between French and American foundrymen, in the form of an official exchange paper from the American Foundrymen's association, submitted by Prof. A. E. White of the University of Michigan, Ann Arbor, Mich. Professor White's paper, which dealt with malleable castings was read by E. Ronceray of Bonvillian & Ronceray, Paris, and was received with acclamation.

The chairman of the congress was Emile Ramas, president of the Association Technique de Fonderie de France and general manager of the Societe Francaise Griffin, Paris. M. Mengin, mayor of Nancy, was present at the opening of the session. In his presidential address M. Ramas extended greetings to the nations which by their co-operation have helped to bring about vast improvements in foundry practice in the past few years. The speaker previously had alluded to a work published 200 years ago by the eminent French scientist, Reaumur on "The art of converting forged iron into steel and the art of softening molten iron or of making objects in molten iron comparable in finish to forged iron."

The first paper, which was summed up by its author, Christian Kluytmans, engineer at Chaumont, France, related the various factors having an influence on the production of hard castings. M. Kluytmans emphasized the importance of scientific researches in conjunction with foundry practice. In this paper it is stated that accuracy is essential in estimating and furnishing a suitable volume of air to the cupola. Among the author's recommendations are the following: The fan should be placed as near the cupola as possible; the total section of the tuyeres should be about one-fifth of the section of the cupola at its largest diameter; two rows of



NEW DESIGN OF MALLEABLE TEST PIECE SUGGESTED BY FRENCH ENGINEER—THE ANGLE A IS SAID TO BE PROPORTIONATE TO THE ELONGATION

tuyeres are advisable. The most favorable height of the cupola is about five times its diameter. The charges should be of uniform thickness, the larger fragments being in the center. With reference to the temperature at which tapping should take place, the following suggestions are offered: For thin castings with high silicon and low carbon, the metal should be tapped at a high temperature; for thick castings with low silicon and high carbon, a comparatively low temperature is advisable. The influence on the final product of silicon and carbon and of the rapidity of cooling are also dealt with clearly in the paper.

The two following papers, which were of great interest, were communicated by J. Seigle, professor of metallurgy at the Ecole Superieure de la Metallurgie et de l'Industrie des Mines de Nancy. In his first paper, M. Seigle develops a few remarks on heat calculations (*bilan thermique*) relating to cupola furnaces. He points out the difficulty of obtaining a really accurate control of the cupola in this respect with the means of investigation available at present. In his opinion, it is advisable to refer all calculations and comparisons to the weight of one kilogram of carbon. The paper and the ensuing discussion brought to light the fact that analyses of cupola gases are inaccurate in most cases; that the calculation of calorific losses from radiation and accessory causes are most uncertain; and that the temperature in the region of the tuyeres and the temperature of the molten iron and slag in the cupola cannot be obtained with precision. With reference to the blast, the knowledge of the pressure and volume of the air is most useful, but insufficient owing to many variables which cannot be measured.

M. Seigle's second paper on "The Physical Properties of Castings and Their Relation to Their Composition and Cooling Conditions" gave rise to a most interesting discussion. Physical properties he said are closely related to the structure, which depends on the precipitation of carbon in the form of graphite. Taking up the elements of the problem Professor Seigle pointed out that, the amount of graphite increases: (1) when the total carbon increases; (2) when silicon increases; and (3) when the rate of cooling decreases. Manganese bears the reverse influence and its increase causes a lessening in the amount of graphite. Phosphorus does not appear to influence the precipitation of graphite, but increases the brittleness and renders the metal more fluid. Sulphur is not troublesome under 0.10 to 0.12 per cent. The different methods of testing castings also were discussed including tensile tests, bending tests, shock tests, brinell tests, etc. The author said these tests are not invariably related to the analysis, for the structure of two castings showing the same analysis will vary according

to the rate of cooling as can readily be observed on castings of varying metal section. In the discussion it was pointed out that the structure of a casting depends also on the temperature of the blast. It also was stated that the influence of a slight excess of phosphorus is not necessarily bad but that sulphur should be carefully avoided.

Grading Pig Iron

The discussion then turned on the classification of pig iron and the advantages of a classification by analysis as used in the United States. Members of the association are in hopes that this method will be adopted in France and Belgium, but it is feared that strong opposition will be met among foundrymen in general. Finally, Joseph Leonard, president of the Association Technique de Fonderie de Liege, suggested that a standard method of analysis be adopted. He is also in favor of abandoning tensile and shock tests while maintaining the brinell test, which he said gives valuable information where castings are to be machined.

The last paper of the day was read by E. Ronceray, managing director, Ph. Bonvillain & E. Ronceray, foundry equipment manufacturers, Paris, on the new methods of testing pig iron. Alluding to the work of Messrs. Portevin and Fremont on the subject, M. Ronceray pointed out that test pieces should be taken from the casting themselves. Tensile and shock tests should be rejected he said. M. Fremont suggests one bending test in order to examine the metal, and one shearing test on a small testpiece, previously machined. M. Portevin suggests besides a brinell test and a test based on the sonorousness of the casting.

The second session, Oct. 6, was presided over by Joseph Leonard, president of the Association Technique de Fonderie de Liege, Belgium. This session was especially devoted to malleable iron and was opened by an address by M. Ramas who commented upon the work of Reaumur alluded to during the previous day. Printed extracts from Reaumur's "Memoires" had been distributed to all members present at the congress.

Then followed a paper, by L. Piedboeuf, managing director of the Fonderies & Ateliers Simonon, Herstal-Belgium, on "Methods of Testing Malleable Iron." This subject was previously discussed during the Liege congress in 1921. M. Piedboeuf related the results of tests made at the Simonon foundry: Regarding the chemical composition, special attention was devoted to the percentage of silicon which varied from 1 to 3.5 per cent; phosphorus was never beyond 0.15 and sulphur not over 0.05 per cent.

Physical properties were studied by means of a bending test, on the American type of test piece, which gave the best results. A good control was obtained by means of two test pieces for each heat, one for the aspect of the metal as it comes out of the cupola, and one to be used after decarburization. M. Piedboeuf points out the importance of the studies effected in America, England and, recently, in Germany where a questionnaire was addressed to foundries of malleable castings by the committee organized in Germany for the testing of this product.

New Malleable Test

In the discussion which followed a new design of test-piece was suggested. This is shown in the accompanying sketch. It was stated that the angle of the bend *A*, measured when a fissure appears, is proportionate to the elongation.

The subject of the next paper was also about the results obtained from the methods of testing indicated at last year's meeting. M. Marcel Remy, foundry proprietor at Herstal, Belgium pointed out the necessity of pursuing the study of shrinks in malleable iron. He cited particularly the opinion of Mr. Touceda who states that cementite in a free state can be detected in all shrinks.

The next paper was read by M. Toussaint Levoz, of Namur-Belgium. Mr. Levoz is the inventor of small converter with a lateral blast. The first converter of this type was constructed in 1888 and caused much criticism. A series of improvements were effected and the present type of small converter came out in 1894. Its capacity is of 800 to 1700 kilograms, or 0.8 to 1.7 tons. Quite recently, it was said, steel castings have been obtained direct from the ore by means of this converter.

The paper which was received from Messrs. A. E. White, of the University of Michigan and H. E. Gladhill, was presented by Mr. Ronceray. This paper covers researches which were made on the minimum time during which a metal of a given composition should be maintained at a fixed temperature during the anneal and the rate at which this metal should be cooled, to obtain a state of equilibrium in producing malleable iron from white castings. The use of electricity as a means of annealing was considered. In the laboratory the usual time of annealing was reduced from 200 hours to 34. In common practice it is expected that a longer period of annealing probably will be necessary, but that eventually this can be accomplished in considerably less time than 200 hours. The remarkable results obtained with American malleable iron greatly aroused the interest of those present, and it is hoped that European foundrymen will soon be able to produce a metal with a tensile strength and elongation comparable with that made in America.

G. Masson, engineer at Sclessin, Belgium, then gave a summary of the work effected by the committee named at last year's Belgian congress to deal with the cost question. The divisions of the report are as follows: (1) Cost of production of melted metal; (2) wages; (3) miscellaneous costs, such as warehouse expenses, overhead expenses, sales costs; (4) sundry remarks.

The final session, Oct. 7, was presided over by M. Damour, steelmaker, of Bayard, France, and vice-president of the A. T. F. Leon Brasseur, engineer, Luxembourg, read a paper on the use of the electric furnace in bronze foundry practice. Interesting results have been obtained at the Acieries Reunies de Burbach-Eich-Dudelange in its Dommeldange plant by using an alkaline-manganese deoxidizing composition on top of the bath, in a hermetically closed induction furnace.

The next paper, by Albert Portevin, professor at the Ecole Centrale des Arts and Manufactures, Paris, related to the influence of phosphorus on brass. Experiments show that physical properties are not influenced by phosphorus under 0.05 per cent. Over 0.05 per cent, the brittleness and hardness of the alloy increase rapidly. After giving the results of micrographic examination, M. Portevin pointed out once more the mistake of submitting to tensile tests metals or alloys which are characterized by small deformation before rupture. The influence of the rate of cooling on physical properties is also brought forward, hence the necessity of taking testpieces from the casting itself.

A New Aluminum Alloy

The subject of the last paper, presented by M. de Fleury, covers a new aluminum alloy which contains 13 per cent silicon, and is prepared by a patented process. The specific gravity is 2.64; its resistance to atmospheric agents is said to be equal to that of aluminum; it is water-tight and air-tight; its contraction is comparable to that of pig iron; the tensile strength is over 19 kilograms per square millimeter (27,000 pounds per square inch); elongation per cent, over 5 kilograms, with R+E greater than 25; this alloy also has interesting qualities as regards friction. It is pointed out, that parts made of this alloy should be of greater dimensions than when made of steel.

The congress concluded with the annual banquet. During the three days, visits were made to local industries, among which were the Fonderies de Frouard. This plant specializes in roll castings. The French Thomson-Houston foundry also was visited. It was decided that the next congress, in conjunction with which an exhibition will be organized, will be held in Paris in 1923.

MICROSCOPY OF CAST IRON

(*Continued from Data Sheet No.* 452)

A convenient size block is ⅝ x ⅝ x ⅜ inch. If the microscope is not of the inverted type some care must be taken to insure the optic axis being vertical to the face of the specimen. If a surface grinder or milling cutter is available two of the specimen faces should be finished parallel. If it is not possible to prepare two parallel faces the specimen must be mounted in some material of low melting point such as Woods metal set in some plastic material, as plaster paris held by a magnetic specimen holder, or supported by some mechanical device. The ingenuity of the operator will indicate the best method to use for any individual case.

Grinding—The prime requisite in successful grinding and polishing is *patience*. The specimen is first ground on the coarse wheel changing to finer wheels until the wheel whose abrasive is the equivalent of 00 or 000 Hubert emery paper is reached. In grinding care should be used to obtain and preserve a plane face. At each change of abrasive, the specimen should be brushed and turned so that the grinding marks are at right angles to those left by the preceding wheel. Grinding should be continued until the marks left by the preceding wheel are completely obliterated. The pressure used by the operator should be just enough to remove the metal at a reasonable rate. Any undue pressure will cause deep scratches which are troublesome to remove. The grinding wheels must be kept in good condition. Any scratches or adhering particles on a wheel make it impossible to prepare a specimen properly. Any concave or convex curvature on the (side) face of the wheel makes it impossible to obtain a plane face on the specimen. Oil or grease on the specimen face will cause a glaze to form on the wheels, especially on the finer ones, and good grinding cannot be accomplished. Wheels should be inspected frequently and resurfaced whenever necessary. To resurface block the wheel out on the shaft so that its face is slightly beyond the guards. Then turn on the motor and prepare a new surface with a medium coarse file. A little practice will enable the worker to do a good job of resurfacing quickly. As grinding wheels for metallographic work are expensive a little time spent on resurfacing will save money.

(*Continued on Data Sheet No.* 454)

MICROSCOPY OF CAST IRON

(*Continued from Data Sheet No.* 453)

Hand grinding on emery papers often proves satisfactory. The paper should be placed on a flat board. The rules on turning the specimen, pressure, etc., apply to hand grinding. Number 00,000, and in some cases 0000, Hubert papers, or their equivalent, should be used for the last grinding. Hand grinding sometimes proves less difficult than grinding on wheels, therefore the laboratory should keep the proper emery papers in stock.

Grinding belts are often used for rough grinding. Some laboratories use emery papers glued onto wooden disks in place of regular grinding wheels.

The last (or fine) grinding often is done on a horizontally mounted wheel, using canvas backing and emery flour in water.

Polishing—While care and patience are necessary in grinding they are doubly needed in polishing. Polishing is an art, and the only way to master an art is by intelligent practice.

The final grinding should have left a plane face with a series of fine nearly parallel lines. There must be no deep scratches. If the grinding has not been done correctly it is no use to begin polishing. If the scratches are not very bad and the face plane, yet the operator feels he cannot remove the scratches by polishing, he can place the sample in nitric acid (1 to 1) a few moments, remove it, wash well, wipe thoroughly, and regrind on the last wheel until all traces of etching are removed. This treatment often proves useful in removing *stubborn* scratches, and grinding will remove all etching marks. If the edges of the specimen need not be examined they may be bevelled off. This prevents tearing the polishing cloth.

For gray iron work the author uses tripoli powder for the first (and last) polishing. With proper care and moderately hard materials, tripoli powder in water (to which a small amount of gum arabic or similar substance has been added) is a good all round polishing abrasive. The 6-hour, No. 2, alumina is preferred by some. It is more expensive and gives results similar to those secured with tripoli.

(*Continued on Data Sheet No.* 455)

THE FOUNDRY DATA SHEET, NOVEMBER 15, 1922
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

Patterns Are Bedded in the Floor

The Jobbing Foundryman Willing To Accept Any Order within His Shop's Capacity Is Kept Busy Adapting His Equipment To Meet Conditions from Day to Day

BY R. H. PALMER

IN MANY foundries all patterns are molded exclusively in flasks of two or more parts. In others small patterns are molded in flasks while the bedding-in system is practiced in the production of large and medium sized castings. In others again, although not to any extent in this country, the small as well as the large patterns are bedded in the floor. Each foundryman will claim points of superiority for his system, for few foundrymen view a problem from the same angle. One may operate a modern foundry with ample storage room for flasks and patterns and adequate equipment for transferring them rapidly from one point to another while a second foundryman may be handicapped to that extent. The second man if operating a jobbing foundry is called upon for a great variety of castings at short notice and has to adapt his flasks and rigging and employ makeshifts for special work. The use of expensive special rigging for the sake of one casting might well mean a loss instead of a profit on the job.

In the foundry operating on a special line, flasks are arranged for the patterns in constant use. These flasks are made to conform closely to the shape of the pattern and are stored in a convenient place when not in use. In a general jobbing foundry many of the flasks are constructed in such a manner that they may be lengthened out or contracted by adding or taking away sections

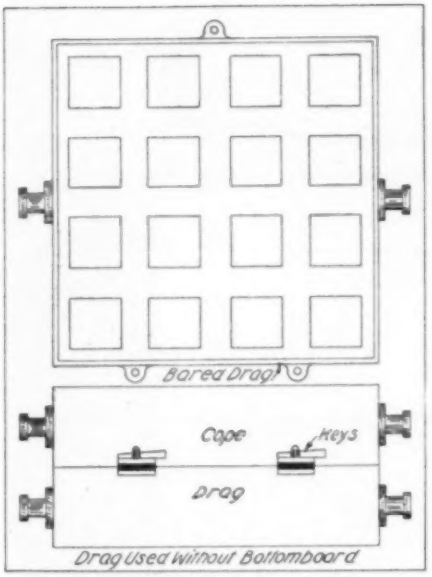


FIG. 1—FLASK WITH BARS IN THE DRAG

provided for that purpose. Flasks similar to that shown in Fig. 1 provided with a number of flat bars across the bottom of the drag are used extensively in Great Britain but rarely are seen in this country. Usually the patterns are bedded in these drags, but they may be rammed in the usual manner and rolled over if the pattern is not too deep. In the latter event the drag is placed on the floor, joint side up and any projecting parts of the pattern are allowed to drop through between two of the bars. The only advantage of using this style of drag lies in the fact that it does away with using a bottom board or plate. The pins in the flask shown in the illustration are provided with slots into which, after the mold is closed, the molder drives flat keys which hold the two parts of the flask together. In many shops the pins are not fastened permanently to the flasks. They are used to guide the copes into place and then are removed. In this manner one set of pins will serve many flasks and besides there is no danger of breaking them when shaking out the molds after they have been poured.

In making the molds shown in Figs. 2, 3 and 4 the molder in one foundry places the drag half of the pattern joint side down on a follow board, places his drag flask around it, covers the pattern with facing sand then fills the flask with successive layers of heap sand, ramming each layer in turn until the flask is filled. He then clamps a board on the bottom and rolls the half mold over on the floor. In this instance the sand forming the joint face of the mold is rammed first. The molder in a second foundry may proceed in a directly opposite manner in that the sand forming the joint face of the mold is the last portion to be rammed.

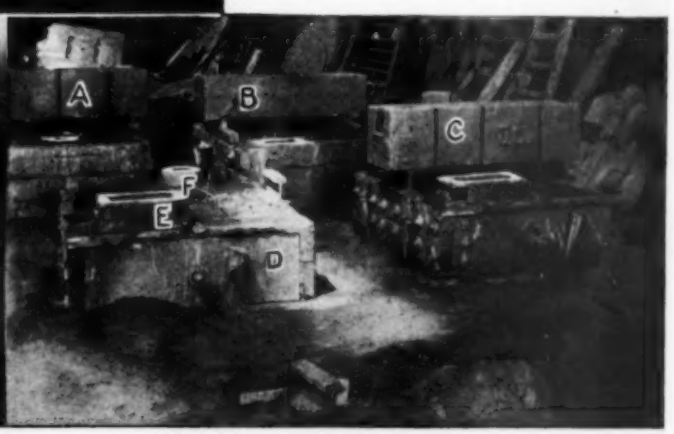


FIG. 2—HALF OF THE PATTERN IS MOLDED IN THE FLOOR, THE OTHER HALF IS MOLDED IN A COPE FIG. 3—DRAG HALF PARTLY RAMMED FIG. 4—MOLDS ASSEMBLED READY FOR POURING

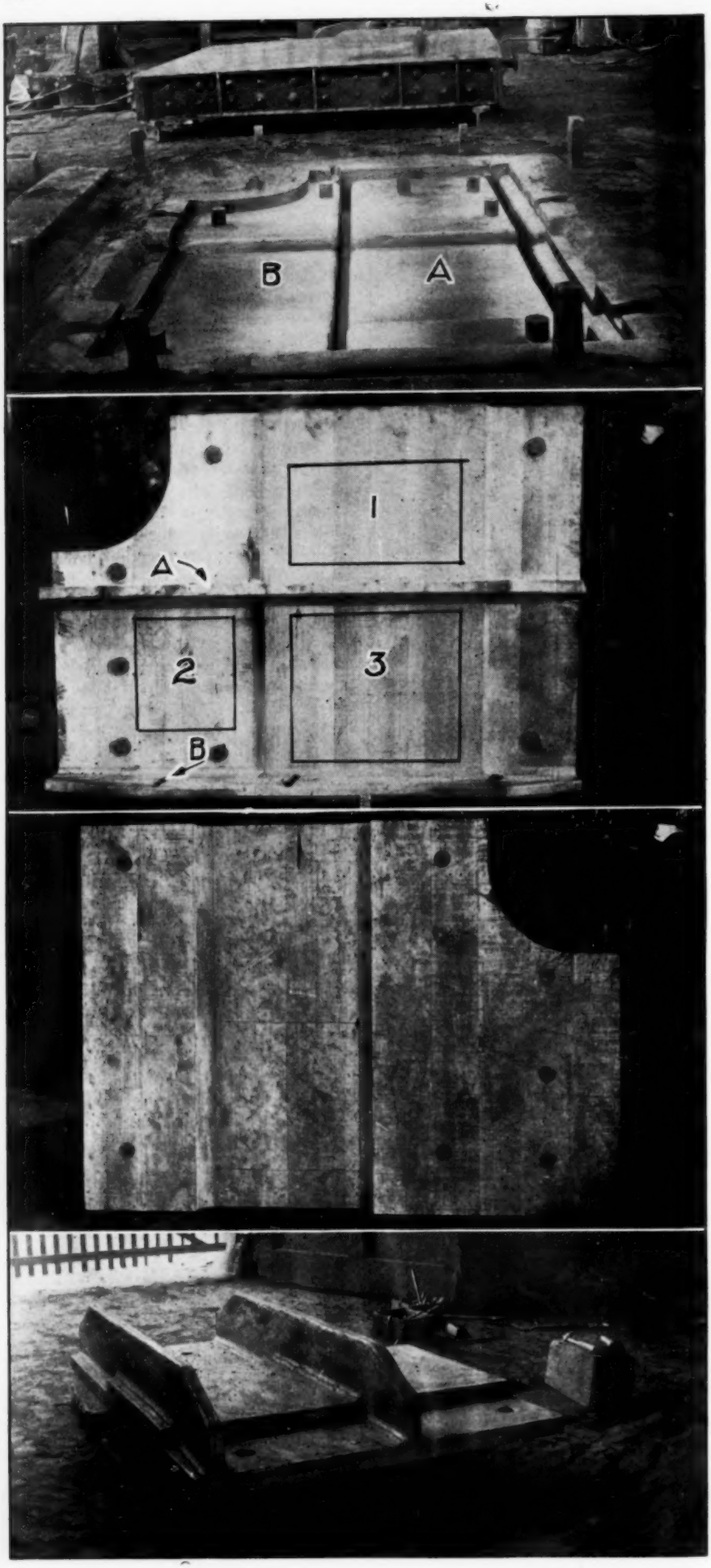


FIG. 5—COPE AND DRAG OF THE FINISHED MOLD FIGS. 6 AND 7—THE PATTERN FIG. 8—THE CASTING READY TO BE SHIPPED

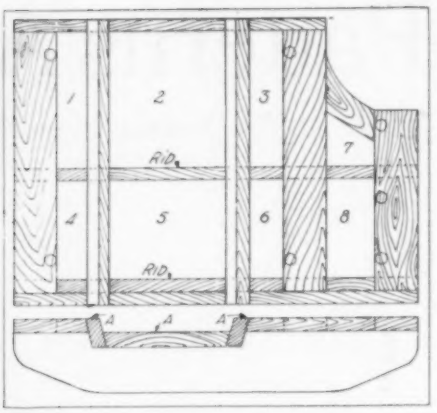


FIG. 9—SKELETON PATTERN FOR PLATE

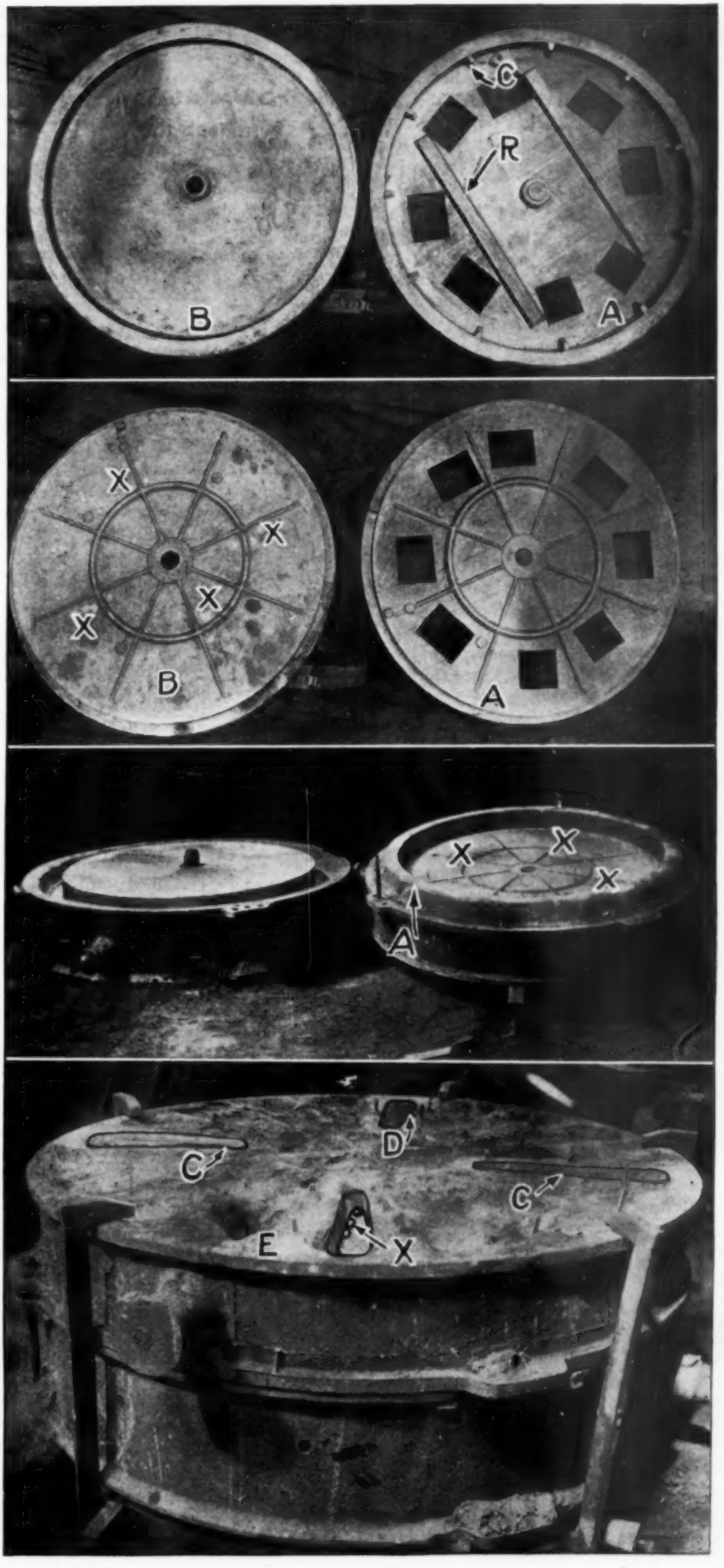
He digs a hole in the foundry floor and in it places the drag half of the pattern joint side up. He adjusts the pattern and tucks black sand under it. The pattern then is staked and taken out while the molder feels the face of the mold for soft spots. Having satisfied himself that the face is firm he covers it with a thickness of facing sand and returns the pattern to its place. A piece of wood is laid across the top and with a sledge hammer the molder raps the pattern down to a solid bearing. Facing sand then is banked up against that part of the pattern representing the casting at which point it appears as in Fig 3. The remainder of the hole then is filled with heap sand and rammed until it is flush with the floor.

The cope is rammed alike whether the drag half of the mold is made in a flask or in the floor. In the first instance pins and pin holes in the cope and drag serve to guide the cope back into its place after the two halves of the mold have been finished. In the second case as shown in Figs. 2 and 4, stakes driven into the floor alongside the cope serve the same purpose. Where one half of the mold is made in a drag it is vented before it is rolled over. Where it is made in the floor the vent holes are driven down from the joint before the pattern is drawn.

The cores for the molds shown

in Fig. 2 are counterbalanced and require no chaplets to hold them in place. The castings weigh 1100 pounds each. Two different styles of copes are shown in Fig. 4; *A* and *B* are provided with iron ends and iron bars while the other two each represent a cope and drag cleated together to form copes. After the present job is finished they will be taken apart and used as originally intended. In the illustration *A* and *B* are shown with the wooden sides bolted to the outside of the iron ends. For another job it is quite probable that the sides may be bolted on the inside of the end flanges.

Two ways of making the pattern for the casting shown in Fig. 8 are illustrated in Figs. 6 and 9. In



FIGS. 10 AND 11—FRONT AND BACK OF PATTERN AND CASTING FIG. 12—THE DEEP PARTING IS OWING TO FLAT BARS IN THE COPE FIG. 13—MOLD READY FOR THE IRON

the first instance the pattern is made solid but could be adapted for bedding in by cutting out the sections marked 1, 2 and 3. In Fig. 9 the pattern is made as a skeleton; it is molded easily and lumber is saved in its construction. The jobbing founder frequently has no voice in the construction of the patterns furnished and in the instance illustrated made the casting off the pattern as shown in Fig. 7, by bedding it in the floor.

Two straightedges corresponding in shape and thickness to the ribs on the pattern were leveled in a pit in the foundry floor and spaced the same distance apart as the ribs on the pattern. A cinder bed was placed between the straightedges and also on the side marked *B* in Fig. 5. This cinder bed extended beyond the pattern at each end. Facing sand was banked against the ribs and then the remainder of the pit was filled with heap sand and rammed up approximately level and flush with the upper edges of the loose ribs, the last inch being made up of facing sand. The face was then vented thoroughly after which the face was scraped off flush, fillets cut alongside of the ribs and then the ribs were taken out of the sand. The pattern was lowered into place and rapped down to insure an even bearing and then gate cores were tucked into

place at the ends of the ribs at the wide end. The cope was a tight fit and on that account the gate cores were kept about 4 inches below the joint and extended outside the end of the cope. Stakes driven down flush with the joint at the four corners helped to support the weight of the cope.

If the pieces 1, 2 and 3 Fig. 6 had been made loose the pattern could have been placed in the pit and wedged up to the desired position. Sand could have been rammed under from the outside and also through the openings. After the sand had been rammed as high as the under surface of the pattern it could have been scraped off flat and the loose pieces dropped into their respective places. The skeleton pattern shown in Fig. 9 would have been the most convenient form to bed in the floor. It could have been placed in the pit, wedged up level and then filled and rammed full of sand. After the cope had been taken off the sand between the different parts of the frame and indicated by numbers from 1 to 8 could have been scraped out to a depth of 2 7/8 inches, the thickness of the required casting

Pour at Four Points

Usually the pan shown in Figs. 10 and 11 is rolled over but occasionally it is more convenient to bed it in and for that purpose the square holes are cut through the web as shown. The pattern is 54 inches in diameter, 5 inches deep and 5/16-inch thick. The battens *R* Fig. 10 of course are merely intended to hold the pattern rigid and the cavities which they leave in the face of the mold are filled with sand after the pattern has been removed. In Fig. 12 it will be noted that the pattern had to be kept below the joint on the drag and that the parting around the rim had to be made down on a slant because an ordinary cope with straight bars was employed. On account of the thin section of metal and the large surface to be covered the casting was poured at four points as shown at *A*, *B*, *C* and *D* Fig. 13 and at *x* Fig. 12. The basins on top of the cope were quickly filled with iron thus effectually choking the small pop gates and insuring a clean casting. These castings which were machined practically all over were made from a mixture of No. 2X foundry pig iron, No. 2 charcoal iron and machinery scrap.

The pattern was faced with Albany No. 1 sand in the proportion of one part of sea coal to 14 parts of sand. Pieces of cake cores were bedded in the face of the mold directly under the pop gates to receive the first fall and wash of the iron. Before closing the mold it was given a coating of plumbago. In this connection it is interesting to note that if for any reason it is desirable to pour thin castings with iron a little on the dull side a thin coating of talc over the lead will help the iron to flow faster and farther than it would over the lead alone.

Will Produce Fluorspar

Jay L. Hench, widely experienced in the iron and steel business, has become vice president and sales manager of the Hillside fluorspar mines, with offices in the First National Bank building, Chicago. This company is carrying on a campaign among the steel works and foundries with the object of showing how an increased use of fluorspar will benefit operation. Mr. Hench was born at Hinsdale, Ill., April 11, 1885. After the usual schooling he had a special course in iron and steel analysis at Cornell university, 1903-1905. Following a short period in the bessemer and open-hearth departments of the Illinois Steel Co., he spent the years between 1906 and 1911 as a salesman for Joseph T. Ryerson & Co., Chicago. In the latter year he became sales agent for the Lackawanna Steel Co., Buffalo, covering Indiana and Michigan. In May, 1919, he was made district sales manager for the same company in Chicago, where he remained until early in the present year when he resigned to take up work for himself dealing in iron and steel products.

Maine Foundry Moves

The Fellows Brass & Iron Foundry, Auburn, Me., will move within a few weeks to Waterville, Me., where it will remodel and occupy the old Lombard foundry plant which has been idle for five or six years. Lloyd McFadden of Auburn will start a foundry in the building vacated by the Fellows Brass & Iron Foundry.

Gives Data on Heating

A booklet giving comprehensive data on the elements of industrial heating, of value to foundrymen, has been published by the W. S. Rockwell Co., New York. After a general survey of industrial heating processes the factors governing quality and cost of heat treated products are explained together with the relation of temperature control to uniformity of heated product. In discussing the influence of the design of furnaces many sketches are given to illustrate construction of furnaces for different purposes. Fuels also are dealt with extensively in their relation to costs and heating value, and the factors governing the selection of the proper fuel for different purposes are explained.

Blast Pressure for Cupola

Question: What is the proper blast pressure in ounces for a cupola lined to 30 inches?

Answer: Under ordinary circumstances and with other factors normal, air delivered at a pressure of 10 ounces will melt iron in a 30-inch cupola in a satisfactory manner. However, pressure in itself is not a reliable indicator, nor a proper basis on which to build a theory from which to draw conclusions. A 30-inch cupola if handled properly will melt 3½ tons of iron an hour and since 30,000 cubic feet of air is required to melt 1 ton of iron it follows that 3½ x 30,000 cubic feet will have to be blown into the cupola in an hour to melt 3½ tons of iron. It does not make any material difference at what pressure the air is supplied provided the proper volume is furnished, but with the type of blower used on cupolas it has been found that the most economical arrangement hinges on a blower working at about 10 ounces pressure for cupolas 30 inches in diameter. Under certain circumstances the pressure reading may be misleading. For instance after the cupola has been in blast for some time and the tuyeres are partly choked, the gage will show an increased pressure when in reality less air is entering the cupola than when the gage gave a lower reading. Pressure is only a secondary consideration. Provide means for admitting a sufficient volume of air into the cupola and the pressure will take care of itself.

Investigates Alloys of Brass and Bronze

The bureau of mines states that the Pittsburgh station heat-treatment experiments, including quenching and annealing, have been conducted on a number of cast alloys including the following: 88:10:2 Cu-Sn-Zn; 85:5:5:5 Cu-Sn-Zn-Pb; 85:4:5; 6 Cu-Sn-Zn-Pb; 90:10 Cu-Sn; 90:6:3:1 Cu-Sn-Zn-Pb; 85:15 Cu-Sn; 86:4:6:3:1 Cu-Ni-Sn-Zn-Pb; and 89.9:10:0.1 Cu-Sn-P. The results are being summarized.

A report of the American consul at Colombo, Ceylon, covering imports of the principal classes of machinery into that country indicates that in 1921 foundry and workshop machinery was imported to the value of $413,017.16, of which America supplied $26,908.17, or 6.52 per cent.

Converter Makes Better Steel

Attention To Melting and Blowing Adds To Quality of the Metal—Cupola Operations Different from Gray Iron Melting—Ferromanganese and Ferrosilicon the Principal Deoxidizers—Aluminum Not Essential

BY RALPH BURKE

THE past few years have seen the small converter fall more and more into disrepute for making steel castings. The standard of melting scrap was lowered during the war, making it increasingly difficult to obtain low-phosphorus and low-sulphur stock, and at the same time good coke was hard to obtain. Coupled with the tendency of most foundries to increase the percentage of scrap in the charge with the rise in price of low-phosphorus pig iron the result has been a poor grade of steel, with accompanying shrinks, cracks, and kindred ailments. However, the converter is in a class by itself for flexibility and versatility. For this reason many of the converter shops have retained their converters, improved their melting practices, and modified their molding operations, with the result that they are again producing satisfactory steel castings.

Starting from the melting end of the foundry, the first aim of the melter is to eliminate the factors causing excessive shrinkage or excessive red shortness of the steel. It generally is recognized that sulphur is one of the detrimental elements, causing red shortness, and that phosphorus in excess has a tendency to cause excessive shrinkage, while making the steel set quickly in the mold and thus preventing the risers from properly feeding the casting. Satisfactory steel may be produced with high sulphur, or with high phosphorus, but never when both elements are present in excess. While no definite figures are obtainable, most converter men who have experimented along these lines agree that a combination of these elements above 0.14 per cent is unsafe. It has always been the easiest way to lay all cracking and shrinkage trouble to high sulphur and phosphorus, in spite of the fact that any given pattern will sometimes come out better when poured with inferior steel than when poured of steel of good analysis, molding and pouring conditions being held the same. This indicates that a third detrimental element is at work, not so easily measured or controlled. This element is found in the oxidation of the steel, either in the cupola or in the converter. Therefore, any improvements to be made for quality of the steel must be by reducing sulphur, phosphorus, and oxidation.

Phosphorus is the element most easily controlled, since the phosphorus content remains practically constant from the charging platform to the casting, with allowance for the concentration due to melting and blowing iron losses. Evidently the only way to get low-phosphorus castings is to buy low-phosphorus pig and scrap. For foundries melting a large percentage of scrap the upper limit for phosphorus should be 0.04 per cent.

The combined cupola and converter loss will vary somewhat, according to the mixture blown, size of vessel, and temperature of metal, but a fair average will be about 13 per cent, allowing 10 per cent for blowing and 3 per cent for melting loss. Thus, if the phosphorus content is 0.04 per cent as charged into the cupola, we will carry the same weight of phosphorus throughout the melting and blowing operations. This constant weight is a larger proportion of the diminished final weight of the charge, or 0.046 per cent. This figure is obtained by dividing the original phosphorus content by the percentage of metal remaining after subtracting the metal loss. In this case 0.04 would be divided by 0.087, giving 0.046 per cent phosphorus in the steel.

Sulphur is an element not so easily controlled. Only the best possible low-sulphur coke should be used. Beside keeping the sulphur contents low the use of the best grade of coke generally will result in a saving on account of giving a better fuel ratio. By improper cupola operation a good grade of scrap may be rendered unfit for casting purposes through excessive sulphur absorption. In general, thin sections of scrap will absorb more sulphur than heavier sections, indicating that plate scrap, flashings, etc., should be avoided. At the same time exceedingly heavy sections require longer contact with the coke before melting, thereby absorbing an excess of sulphur. Scrap should be carefully chosen with a fairly heavy, uniform section. Pig iron should be specified high in manganese, so that the total manganese content in the charge will be about 1 per cent. Also ferromanganese may be used for keeping up the manganese content of the charge. A manganese content over 1 per cent is detrimental to the converter lining.

In blowing converter steel, the increase in temperature of the metal from the original heat of the cupola to the final pouring temperature depends largely on the silicon and carbon contents of the charge, these elements simply acting as fuel when combined with the air from the blast. Since the carbon contents must be more or less as we find it, depending on the amount of pig iron used in the mixture, the temperature variation is obtained by varying the silicon contents. For large work it is not necessary to carry a high temperature, nor is it advisable, as the hotter the steel the more difficulty is experienced in cleaning the sand from the casting. For small work the steel must, of course, be hot as possible, in order to run the casting, and also for the reason that small work

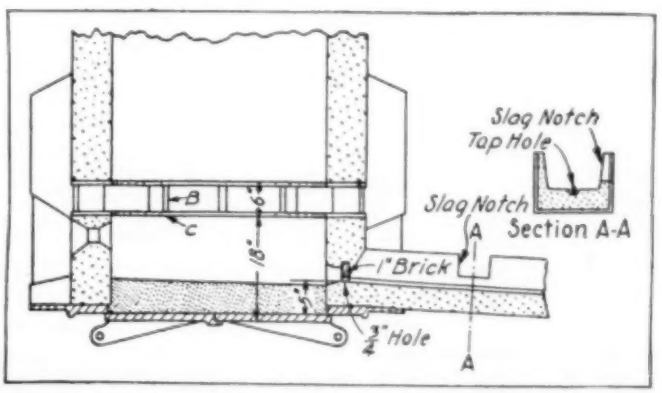


FIG. 1—THE CUPOLA USED TO MELT METAL FOR THE CONVERTER IS DIFFERENT FROM THAT USED FOR MELTING IRON FOR CASTINGS—NOTE THE LOW TUYERES

is usually poured from small shank ladles, and is generally handled twice before being poured into the mold.

The correct silicon content for satisfactory blowing will vary between wide limits, depending on the weight of the castings to be poured, the method of pouring, and the temperature of the cupola iron. For extremely small work, poured mainly with shank ladles, a silicon content of about 2.0 per cent generally will be found satisfactory. The same results will be obtained, with faster blowing, by melting the iron at 1.0 per cent silicon and adding enough 50 per cent ferrosilicon to the vessel during the blow to bring the total to about 2.0 per cent. For heavier work, poured with lip or tea-pot ladles, about 1.25 per cent silicon will be found to give good results, and for bottom-pouring ladles about 1.0 per cent is sufficient.

It will be found that the freedom of the steel from excessive oxidation is just as important in running thin sections as the temperature of the metal. No matter how hot the metal may be originally, if it is full of oxides it will chill rapidly when exposed to the air or a cold surface. On the other hand, metal free from oxides will run when surprisingly cold, and seems to pour better the longer it stands. The ladles in any case must be as hot as it is possible to get them, especially for lip pouring.

The cupola operation generally is the determining factor in quality of the steel. Practices that produce satisfactory gray iron are not at all suitable for the steel foundry, especially those melting a high percentage of scrap. In general, the cupola described and operated as shown in this article has given the best results for economy, elimination of oxidation, and low sulphur absorption. The low fuel bed and high fuel ratio make for economy, and since the cupola runs with the tap hole open the molten iron is only momentarily in contact with the fuel bed. This together with the high fuel ratio, minimizes the sulphur absorption. At the same time the absence of flux is a direct saving in itself, and an indirect saving in the life of the cupola lining.

Referring to Fig. 1, it may be seen that the tuyeres, instead of being the usual separate openings, are made of two cast-iron rings, in segments, separated by iron spacers, *B*. This allows a large volume of air to pass with low blast pressure, decreasing oxidation, and bringing down hot iron. With these tuyeres only short blue flames appear at the charging door when melting. A blast pressure of about 5 ounces is carried, with a volume of about 3500 cubic feet of air per minute. The cupola is lined to 42 inches. The tap hole is made ¾ inch in diameter by filing a notch in a 1-inch brick and placing it as shown. The tap hole is never closed except for the few minutes when transferring iron to the converter, and both iron and slag leave the cupola from this hole. To take care of the slag, a narrow trough is made in the spout for the iron and a firebrick is laid over this trough. The brick allows the iron to run under it, but cuts off the slag, deflecting it over a notch cut in the side of the spout as shown. Since no limestone is used, the slag becomes pasty as soon as it strikes the air and is easily handled, but by being in contact with the hot iron remains fluid enough to clear the cupola and run freely from the hole. As soon as the ladle is filled the blast is shut off, the tap hole stopped off, and any slag cleaned away from the spout ready for the next tap. This cupola delivers hot iron with no less than an 8 to 1 coke ration.

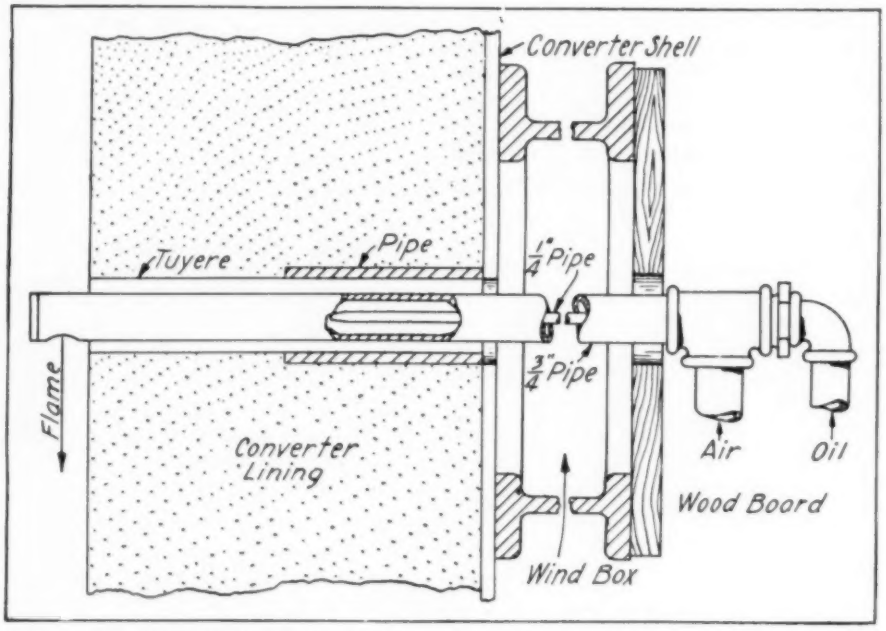


FIG. 2—AN OIL BURNER INSERTED THROUGH A TUYERE SERVES TO HEAT THE CONVERTER PREPARATORY TO BLOWING STEEL

The reason for shutting off the blast between taps under this method of cupola operation is to prevent any molten iron from remaining in contact with the coke bed, and to give the cupola tender opportunity to prepare his spout and remove slag from the runner. The time between taps should be as short as possible, and generally 3 or 4 minutes should be enough to empty the ladle into the converter and return it to the cupola. In ordinary cupola practice, the blast, of course, should be kept on as continuously as possible, and is generally regulated according to the requirements of the converter.

High Grade Refractories

The converter, while simplicity itself, requires a great deal of minute attention, especially as to proper lining. Only the best of refractories should be used, as with poor material the vessel soon becomes distorted as to shape, making irregular blowing, and the heavy slag produced by the melting lining causes no end of trouble in pouring and with the ladles. The tuyeres require careful attention to insure that all the blast goes through them, instead of partly between the lining and the shell to seep through the lining in another place and cause bad blows. Ganister is generally favored over brick for this reason, although good results can be obtained with both kinds of lining.

The converter should always be clean of slag, the tuyeres as level as possible and the vessel at least at a good orange heat before putting in the first iron. An oil burner is perhaps the best method of heating a converter, being clean, fast, economical and positive.

Fig. 2 represents a section of converter through a tuyere. The tuyere is shown made half its length of common pipe, tight against corresponding hole in the shell, to prevent air leaks behind the lining. At the same time these pipes once set level, form a guide for patching the tuyeres. The burner

is of a type common for this purpose, consisting simply of a ¼-inch pipe for the main body, with a ¼-inch pipe inside for the oil. When in use the converter blower is run at about 1 pound pressure or less, while the high-pressure air serves to break up the oil. The open end of the large pipe is plugged up, and an outlet for the flame provided by drilling a ½-inch hole in the side near the end, allowing the flame to strike downward to heat the bottom. Such a burner will heat a dry lining ready for steel in 20 minutes. In repairing the converter the ganister in front of the tuyere pipes is chipped away down to these pipes, to insure clean, solid tuyeres every day.

The usual blast pressure on the converter is about 4 pounds at the start, which may be reduced to as low as 1½ pounds near the finish of the blow, depending on the reaction.

Blowing Angle Greater

For some unknown reason nearly all books on the subject recommend a blowing angle of 5 to 7 degrees. This was evidently satisfactory in the days when the major portion of the charge was pig iron, but is not at all suitable for blowing mixtures of 75 per cent and up of scrap. An angle of 15 to 20 degrees has been found more satisfactory for the prevention of oxidation in the converter. Apparently the larger angle facilitates the removal of the highly oxidized slag, and this slag should be allowed to slop over the mouth of the converter without reduction of blast pressure, as long as the slag is heavy enough to protect the metal itself from the cutting action of the blast. Should the blast be reduced at this stage the slag simply reoxidizes the bath, resulting in poor metal, and increasing the length of the blow, as well as being injurious to the lining. The blowing loss will be found to be lower by this method of blowing than by trying to hold everything in the vessel, probably due to less oxide formation. Near the end of the blow, as the slag becomes light, the blast should be reduced to prevent oxidation of the metal and the throwing out of iron. The flame should be cut short at the end of the blow, as soon as the operator is sure the flame is dropping, instead of waiting until the flame has practically disappeared. This will aid in preventing oxidation, as will be shown by the increased stiffness of the slag on the metal, allowing the metal to be poured into the ladle practically free from slag. Steel, properly blown, or free from excessive oxidation, need not be extremely hot to run well, and will cup down satisfactorily in the risers without the addition of aluminum.

The usual deoxidizers used in converter steel are ferromanganese and ferrosilicon. Since ferromanganese has a rather high melting point the most efficient way to make the addition is in the melted form, but for the small quantities used in each ladle, the cost of melting is prohibitive. In a normal blow, when using molten ferromanganese, the loss in manganese, that is, the amount used up in the actual deoxidizing, is about 10 per cent. The next most efficient way is to heat the manganese, in small lumps, in the ladle while the ladle is being heated. This gives a good mixture, but the loss is about 20 per cent. However, in most small foundries the same ladle is used over and over, with little time between blows, making it impossible to preheat the manganese in this way. In this case the manganese, in large lumps, is wetted and thrown into the bath as soon as the blow is finished, and the vessel is in a horizontal position. While the loss, due to a large amount of the manganese going into the slag, is about 50 per cent by this method, it is about the simplest and most convenient way of making the addition, and gives good results.

Ferrosilicon Added in Ladle

Ferrosilicon, with its low melting point, will have satisfactory results if broken up in small pieces and added in the ladle immediately before pouring in the steel. Other deoxidizers besides ferrosilicon and ferromanganese are on the market. These are usually used for especially high grade steel, together with the regular manganese and silicon.

With properly made steel the addition of aluminum usually is not necessary or desirable. Aluminum will lower the tensile strength and ductility, and its use should be watched closely. In general the use of aluminum, in amounts of 1 ounce to 100 pounds of steel is recommended as a safeguard against pin holes where there is danger of a damp mold, or where wheat flour or other vegetable matter comes in contact with the steel. Where it is necessary to add aluminum to prevent the steel from *coming back* or mushrooming in the heads, something is wrong in the melting practice. Aluminum is best added cold to the stream as the mold is being poured.

A great many elements enter into the production of castings outside of the melting. To get satisfactory results from converter steel, which at best is the most difficult of all to handle, every foundry must make a study of pouring, gating and molding methods for its particular work. The use of green-sand molds opens a wide field in the cutting down of losses due to cracking, and with proper care and suitable facing a great many molds can better be produced in green sand that would ordinarily be termed dry-sand work. The substitution of green-sand cores with plate arbors for regulation dry-sand cores is often the solution of a hard problem, and in the long run may be found the more economical way as well. Many impossible jobs are made possible by the use of chills, both external and internal. In fact, nearly all classes of work can be made within the capacity of the converter, but, of course, there is an economical limit. However, it is believed that the converter, with careful handling, can hold its own in its field, and that it is well worth while to consider the possibilities of improved practice before deciding to replace the converter with more costly equipment.

Book Review

American Malleable Cast Iron, by H. A. Schwartz; cloth, 416 pages, 6 x 9 inches, illustrated; published by the Penton Publishing Co. and furnished by THE FOUNDRY, Cleveland, for $7 postpaid to addresses in North America and for 35 shillings post free abroad.

In 1826 in a small obscure foundry in Orange street, Newark, N. J., Seth Boyden made a discovery that formed the basis of the present "black heart" malleable industry. The process, which is quite different from that employed in Europe for making "white heart" iron, has been developed almost exclusively in the United States and Canada.

Because the product is so distinctly American in origin and growth "American Malleable Cast Iron" is a logical and significant title for the new book written by H. A. Schwartz, which is just off the press. Containing 416 pages, 190 illustrations and 20 tables, and embracing chapters on history of the industry, methods of manufacture, principles of metallurgy, procedure for tests, and outline of properties, the text constitutes the most complete treatise on American malleable ever published. The work is made more comprehensive by a selected bibliography of nearly 200 references to chapters and articles in English, French, German, Russian and Japanese books and periodicals, and by a carefully prepared index in which liberal cross indexing is a valuable assistance to the reader searching for specific information.

In the eyes of practical men, the worth of a technical book often is measured by the experience and quali-

fications of the author. In this case, the text reflects the observations, study and research of a trained metallurgist whose life has been devoted to problems of the industry. Mr. Schwartz's first duties involved mechanical engineering work, including the design and installation of special foundry equipment and machinery. He served as metallurgist and assistant superintendent of a large malleable foundry and designed, built and organized one of the early works laboratories. He was among the first to establish a sound theoretical basis for works control. His experience of the past few years, embracing the planning and organizing of a research laboratory serving all of the plants of the largest malleable producer has given him a broad knowledge of the problems of the industry. While primarily his work has been in the line of metallurgical investigation, his long familiarity with the operating problems of the plants of the company has given him a more evenly balanced insight into the technique of manufacture, works control, sales and administration than is afforded most men in the industry. Therefore, although the book reflects the viewpoint of a metallurgist rather than that of a plant superintendent, the chapters devoted to operating problems have not suffered from this fact.

In analyzing the text, four principal divisions suggest themselves. Chapters I and II on the history and development of the industry, lead the reader from the time of Boyden through the decades of growth to 1921, and end with a resume of the status of the industry in that year.

Chapter III deals with the metallurgy of malleable, and as such really is the prelude to the following 11 chapters, which cover the various phases of manufacture. Chapter IV includes an outline of the general scheme of production, including a description of the equipment employed. Melting stock, fuel and refractories are discussed in the next two chapters.

Melting practice, which vies with annealing as the critical phase of malleable manufacture, is discussed in three chapters, treating the air furnace, electric furnace, and cupola and open hearth, respectively. Much information, heretofore unpublished is included in this portion of the book, and heat balances for each method of melting are given.

A number of misconceptions concerning the value of packing, length of the annealing cycle, and economy of various types of ovens are exposed in the next two chapters. The metallurgical principles, as well as the practice of annealing, are covered.

Chapters XII, XIII and XIV deal with molding and patternmaking, cleaning and finishing, and inspecting and testing. As a rule, in most foundries the importance of these operations is overshadowed by the more serious aspect of melting and annealing problems. However, in pointing out the cost of haphazard work in these departments and outlining the proper procedure, the author properly emphasizes a point of weakness in many malleable plants.

The five concluding chapters are distinctive in that they contain material never before published in book form. In fact, certain portions deal with the results of recent work which until now have not appeared in type. The chapters constitute a complete study of the properties of malleable, including resistance to tension, compression, bending, shear, torsion, fatigue, impact, hardness and wear, and thermal and electrical properties. One chapter deals with plastic deformation.

Technical as this part of the book may seem to the operating official, its importance is readily apparent when one considers the commercial losses sustained in the past by the malleable industry due to improper conceptions of the properties and limitations of "black heart" iron. These concluding chapters are of particular interest to sales managers of malleable plants, to metallurgists, and to users of malleable castings. The strong and weak points of the product are emphasized with scientific exactness, enabling the reader to obtain a clear idea of the possibilities and limitations of its use. The value of this feature may be judged by the fact that malleable castings find application in the automotive, agricultural implement, building, machinery and railroad industries in the form of harness parts, couplers, chain belt, implement parts, railway draft gears, pipe fittings, journal boxes, car wedges, derailers, rail anchors, electric starting equipment, rear axles, spring shackles, hubs, lamp and windshield brackets, parts for kitchen ranges, radiator nipples, vises, etc.

From the foregoing analyses, it is apparent that as a contribution to foundry literature. *American Malleable Cast Iron* serves a three-fold purpose. It is a hand book of modern malleable practice, a timely record of past and present metallurgical investigation, and a compendium of established information on the permissable uses of the product. As the only complete volume on the subject, it should prove indispensable to producers and users of "black heart" malleable castings.

Stockholders of the American Machine & Foundry Co., meeting in Jersey City, N. J., yesterday approved an increase in capitalization from $2,000,000 to $10,000,000. The company will issue 80,000 additional shares of stock of $100 par value.

Hard Iron Balls Present Pouring Problems

Question: We manufacture from 3 to 5 tons of 1¼-inch hard iron balls daily and would appreciate any information you may be able to give us on methods to reduce the amount of manual labor necessary. At present each molder puts up about 60 snaps, each requiring 40 pounds of iron and as they are poured with hand ladles, the work is hard on the men, especially in hot weather. The white iron chills quickly and we have not found anything that will take the place of the hand ladle. Another feature which complicates the situation is that the hard iron is placed in the cupola in consecutive charges and as it melts rapidly the entire amount must be poured in a short space of time.

Answer: An overhead monorail with pendant loops in which to rest the hand ladle would relieve the workman of the greater part of his burden in pouring the molds. This method has been installed with satisfactory results in some of the big stove shops where in some cases it is necessary to carry iron 300 feet from the cupola. The men stand in line and *catch in* under the constantly flowing stream from the spout in turn, then each man rests the bowl of his ladle in a support hanging from a trolley running on a monorail overhead. The equipment is quite light and the man experiences no difficulty in pushing the ladle ahead of him. As each man passes his floor he lifts the ladle out of the support and pours his mold. The system may be modified and adapted to fit practically any condition.

While it is true that white iron will solidify more rapidly than ordinary gray iron, that factor alone is not sufficient to warrant the use exclusively of hand ladles to pour such comparatively heavy castings as 1¼-inch balls. We assume that they are molded in the usual manner from a plate carrying half patterns on each side. A long, heavy runner is provided on the cope side to compensate for shrinkage and fairly heavy gates connect the patterns with the runner. A bull ladle with a capacity of 250 pounds could be handled by two men and would pour five flasks each trip.

The job is one that lends itself readily to stacking the molds, a feature that saves floor space and facilitates pouring the molds with a large ladle. White iron melts at a lower temperature than ordinary gray iron and therefore its appearance at the spout is deceptive. By slightly reducing the weight of the charges or by increasing the coke in a similar manner the white iron is melted at a higher temperature and poured readily as gray iron.

Aluminum Melting Practice-V

Iron-Pot, Open-Flame and Electric Furnaces Are Discussed in Relation to Fuels, Melting Costs and Percentages of Oxidation Losses—Information Secured from Replies to Questionaire

BY ROBERT J. ANDERSON

TILTING iron-pot furnaces, as used for melting light aluminum alloys, are generally fired with oil or gas. One installation where coke is used as fuel has come to the attention of the writer, but this is to be scrapped and replaced by an electric furnace, according to the plant officials. Tilting iron-pot furnaces are invariably operated as single units, and their general construction is similar to that of the stationary iron-pot furnace, viz., a cast-iron pot is mounted in a furnace shell and heated over its exterior surface by combustion of the fuel. As a rule, the capacity of the tilting furnace is generally larger than the size in which the stationary furnace is built. Thus, furnaces of this type with capacities up to 600 pounds of No. 12 alloy are built, and 300 pounds is a common size.

In contradistinction to stationary iron-pot furnaces, tilting iron pots are mostly run on intermittent heats, i.e., there is no molten heel utilized, and the inside of the pot is scraped thoroughly after each heat. It is easier to clean out a tilting pot than a stationary one. On the other hand, the practice of employing a molten heel is also in force at some plants having the tilting furnace. The pots used in tilting furnaces are always round in shape. Generally the products of combustion do not have much opportunity to come into contact with the alloy during melting, since the pot is heated over its exterior surface by combustion of the fuel; but where the waste furnace gases are discharged through openings at the top of the furnace adjoining the upper rim of the pot, opportunity is given for the gases to come into contact with the metal. However, in both stationary and tilting iron-pot furnaces the metal may be regarded, for all practical purposes, as effectively protected from the products of combustion, in contradistinction to the open-flame furnaces where the incandescent combustible gases are directly in contact with the metal during the melting period.

The tilting furnace presents some definite advantages over the stationary type, since in the case of the latter the liquid alloy must be ladled out into pouring vessels with resultant additional oxidation and also much spattering and spilling. Under foundry conditions, the quantity of furnace scrap (spills and pouring skims) is usually less when the tilting furnace is used. The following information in regard to furnaces of 100 and 300 pounds capacity supplied by a furnace-maker is typical of both stationary and tilting iron-pot furnaces in general.

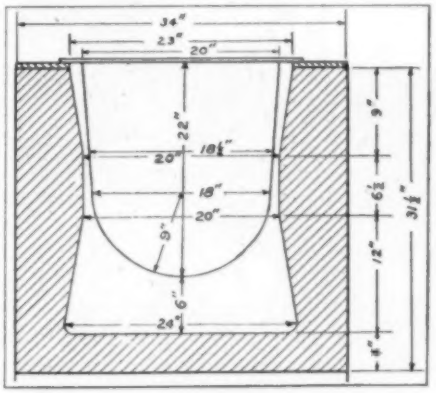


FIG. 1—SECTION OF A TILTING IRON-POT FURNACE

The linings are made of machine-pressed high refractory firebrick, and a cast-iron hinged cover is used. For the pot of 100 pounds capacity, the outside diameter of the flange is 17 13/16 inches and the outside diameter under the flange is 15 13/16 inches. The overall depth of the pot is 14¾ inches. For the 300-pound pot, the outside diameter of the flange is 23⅛ inches, and the outside diameter under the flange is 20⅛ inches. The overall depth is 15⅝ inches. The weight of the 100-pound pot is 100 pounds, and that of the 300-pound pot is 225 pounds. Natural or artificial gas, fuel-oil, or kerosene may be burned. The furnace of 100 pounds capacity consumes about 4 gallons of fuel oil, 4.5 gallons of kerosene, 600 cubic feet of natural gas, or 850 cubic feet of artificial gas per hour. The fuel consumption on the 300-pound furnace is approximately 60 per cent more per hour than is consumed on the 100-pound furnace. When burning oil, the oil pressure is 40 pounds per square inch, and the air pressure about 4 ounces. When burning gas, the air pressure is 4 ounces and the gas pressure 4 ounces. In the case of the 100-pound furnace, the time required for the first heat, when the furnace is started from the cold, is 75 minutes; additional heats when the furnace is run continuously require 60 minutes per heat. For the 300-pound furnace, the time required for the first heat, when the furnace is started from the cold, is 105 minutes; additional heats when the furnace is run continuously require 75 minutes. The furnace consumes about 4.5 gallons of oil per 100 pounds of metal melted. Seven heats can be obtained in an 8-hour working day, and a molten heel is usually recommended. When the furnace is run full time every working day, the lining will require replacement once every 6 months. It is stated that 50 to 55 heats can be obtained from the cast-iron pots. These have an average thickness of side walls of ¾-inch and the bottom is ⅞ to 1 inch thick. The failure of iron pots is attributed to stretching and scaling. Three furnaces require one furnace tender.

Barnes* mentions the use of oil-fired tilting iron-pot furnaces in which the melting loss is 2.5 per cent. A concentric burner is used, with compressed air at 35 pounds per square inch for atomizing the oil. The oil is supplied at about 25 pounds pressure at the nozzle. Both the oil and air are preheated by proper arrangements before they issue from the burner. The volume of air for combustion is supplied through a truncated nozzle surrounding the concentric portion of the burner, and is maintained at about 8 ounces pressure. The atomizing air, oil, and combustion air are controlled by valves and gates so as to maintain a reducing flame whether a slow or fast fire is desired.

Simpson** has patented a tilting iron-pot furnace, fired by gas, with a vacuum device for melting aluminum

*Barnes, E. A., Nonferrous Foundry Economics and Refinements, *Trans.*, Am. Inst. of Metals, vol. 5, 1911, pp. 90-113.

**United States patent 1,118,820, Nov. 24, 1920.

and aluminum alloys. Fig. 7 shows the construction of an iron-pot tilting furnace designed for use in smelting aluminiferous scraps. It is claimed that with the walls built in the shape shown the fuel consumption is about 33 per cent less and the life of the pots 30 per cent greater than in a similar furnace with straight walls. Fig. 8 shows an installation of tilting iron-pot furnaces in a large foundry.

Open-flame furnaces of various designs are favored by some foundrymen for melting light aluminum alloys, chiefly on account of the rapidity of melting. These furnaces, also called direct-flame furnaces, consist of a sheet iron or steel shell, either egg-shaped, pear shaped, barrel shaped or cylindrical, lined with a refractory material and mounted on trunnions. They are fired by oil or gas, and the combustion of the fuel takes place in the space directly above the surface of the metal, therefore the metal is in intimate contact with the products of combustion. In the single-unit small pear-shaped (upright) furnace, two burners are placed in the side at a point midway between the charging door and the pouring spout. The furnace is charged through the door at the top, and the metal is poured through the spout on tilting the furnace to the proper position. The pear-shaped shell is mounted on trunnions. The furnaces may be lined with firebrick or with a rammed lining of gannister and fireclay.

FIG. 8—INSTALLATION OF A BATTERY OF TILTING IRON-POT FURNACES IN A LARGE FOUNDRY

Usually, rather small furnaces of the open-flame type are employed for melting aluminum alloys, a furnace 42 inches in diameter being a common size, although those up to 75 inches are used. For the 42-inch furnaces, 300 cubic feet of air per minute is consumed under a pressure of 12 ounces with two 1⅝-inch diameter tuyeres. Oil is used under a pressure of 25 to 30 pounds, and is preheated to 50 degrees Cent. to ensure an easy flow. When gas is used as fuel the pressure should be about 0.25 pound more than the air pressure. The capacity of the common open-flame pear-shaped tilting furnace for aluminum alloys varies from 100 to 2000 pounds.

Has a Double Chamber

Another form of open-flame tilting furnace is the double-chamber type. This consists of two egg-shaped shells mounted on trunnions with a connecting space between the two chambers. The charging doors are placed at the top of each shell, and the shells may be tilting individually. A burner is provided for each chamber, but only one is used at a time, the operation being conducted as already described for double chamber furnaces.

Another design of open-flame furnace is the cylindrical or barrel-shaped stationary furnace. A burner may be placed at one end, or one burner may be placed on each side of the furnace near the top. These furnaces are mostly of large capacity, built to hold up to 3000 pounds of No. 12 alloy. One design is said to be capable of melting 3000 pounds of metal per hour, or at the rate of 100 pounds in two minutes. These furnaces may be built with two charging doors at one side and one at each end; a pouring spout is placed at the other side. A barrel-shaped rotating and tilting furnace has recently been devised. It is made to rotate, but it tilts at right angles to the direction of rotation. One burner is placed so as to project flame through a hole at one end of the furnace and out through the pouring spout at the other end.

A description of a revolving tilting open-flame furnace has been given* and its performance on brass charges indicated. The same furnace has been applied for melting aluminum.

A barrel-shaped open-flame furnace of a special type is described by Prentiss** as in the development stage. This is an oil-fired furnace and consists of two drums about 7 feet long and 5.5 feet in diameter which operate individually, each taking a maximum charge of 1200 pounds. The furnace has a capacity of 4000 pounds per hour, two heats of about 1000 pounds each being taken from each side per hour. In the operation of the furnace, the cold charge is pre-heated and brought up to a melting temperature in one chamber, while the already heated charge in the second chamber is being brought up to a pouring temperature. After the latter is poured and recharged, the functions of the two chambers are reversed, the flame being introduced from the opposite end. On one side of each drum is a charging door ,and above the door is a pouring spout. A motor is connected to each drum for rolling it over for pouring. Smaller types of open-flame tilting furnaces also are used for melting aluminum.

Reverberatory Furnaces

Reverberatory furnaces are used to some extent for melting aluminum alloys in foundries, but chiefly for melting aluminum for casting into rolling ingots. Their capacity is small when compared with reverberatory furnaces used in brass and copper practice, and they are generally built to hold from 500 to 6000 pounds of aluminum. There are two general types of reverberatory furnaces, viz., those in which the liquid metal is ladled out through a door, and those in which a runner is used for tapping.

Furnaces of large capacity are required in aluminum rolling-mill practice, and it is probably for this reason, and the fact that they can be readily built by workmen around a plant that they have been used for ingot casting. In foundry practice, the reverberatory furnace is applicable where the output is large and continuous, but it is necessary that the production of castings be so planned that large heats of metal are not held in the furnace for long periods of time. The *soaking* of aluminum heats in rolling-mill practice does not appear to be so deleterious to the quality of the metal as it is to aluminum alloys in foundry practice. The

*Anon., Revolving Tilting Metal Melting Furnace, *Metal Ind.*, vol. 16, 1918, pp. 38-39.

**Prentiss, F. L., Modern Foundry for Aluminum Castings, *Iron Age*, vol. 105, 1919, pp. 535-539.

reverberatory furnace is also of value in foundry practice because it permits the charging of large scrap, such as defective crankcases and the like, without first breaking it. Reverberatories are also used for running down borings and other scrap in the production of secondary aluminum and aluminum-alloy pig.

The common type of reverberatory furnace used for melting aluminum and aluminum alloys consists of a firebrick shell bound together with steel girders. The hearth is generally built of firebrick while the roof is arched over from one side to the other, and often arched down from front to back in order to deflect the flame and the hot gases from combustion down upon the metal. Reverberatories are fired with coal, oil, or gas. When coal is used, the fuel is burned upon a grate placed in a firebox at the front of the furnace. Natural draft is generally used.

When fired by oil or gas, the burners are usually placed in the sides of the furnace. The products of combustion are led to a stack by way of a flue at the rear. From two to four burners are employed. It is stated* there is no difficulty in melting aluminum scrap in open-hearth furnaces, and that in such furnaces the oxidation loss is 1.0 per cent on light scrap. Barnes** states that an open-flame reverberatory furnace for melting aluminum alloys was discarded at the plant of the Fort Wayne Electric Works, Fort Wayne, Ind., in which the melting loss was often as high as 6.75 per cent. Fig. 9 shows details of a furnace described by Rhodin.***

At the present time there is as little known about the electric melting of aluminum and aluminum alloys as there was about electric brass melting five years ago.

The General Electric Co. uses a small 75-kilowatt smothered-arc furnace like its older type of electric brass furnace, with a capacity of 75 to 100 pounds, for melting aluminum for rotor castings. This company also has a larger furnace of the same type of about 500 pounds capacity, rated at 150 kilowatts, for melting light aluminum alloys in foundry practice. A much larger furnace of the same type, to hold several tons of metal, has been designed and is to be tried experimentally. The General Electric furnaces for use on aluminum are the same as those for brass, except that in the former the transformer capacity and power input are lower for the same size shell.

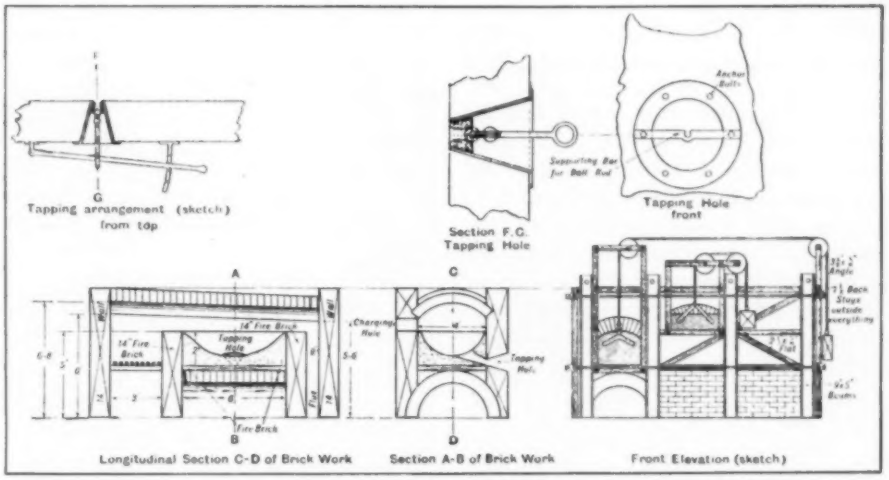

Tapping arrangement (sketch) from top
Section F-G Tapping Hole
Tapping Hole front
Longitudinal Section C-D of Brick Work
Section A-B of Brick Work
Front Elevation (sketch)

FIG. 9—DESIGN OF A REVERBERATORY FURNACE SHOWING DETAILS OF THE TAPPING HOLE

One Baily granular-resistor furnace, 105 kilowatts, is in regular operation in the foundry of the Dayton Engineering Laboratories Co., Dayton, O., for melting aluminum alloys. A test run on this furnace gave an output of about 1.5 tons in 8 hours of actual melting, plus 1 hour for preheating, or 7 to 8 heats of 425 pounds each. The average power consumption is stated to be 625 to 675 kilowatts per ton, and the average power input was only 80 kilowatts. A small 50-kilowatt Baily furnace was in operation at the plant of Landers, Frary & Clark, New Britain, Conn. This furnace gave an output of 0.5 ton of metal per day, melting 9 hours and being preheated 4 hours. The net metal loss was said to be about 0.7 per cent.

A few experimental heats of aluminum have been made in Snyder direct-arc furnaces, but no data are available. The Rennerfelt indirect-arc furnace of 50-kilowatt size was used at one time in making intermediate aluminum alloys. A similar furnace of 100-kilowatt capacity is used now for the same purpose by the Baush Machine Tool Co., Springfield, Mass. A standard Detroit rocking indirect-arc furnace at the C. B. Bohn Foundry Co., Detroit, has been used for melting aluminum alloys. The net melting loss in this furnace is given at 0.85 per cent. This furnace has also been used for making 50:50 copper-aluminum alloy. The Ajax-Wyatt furnace has not been tried on aluminum or aluminum alloys.

A great many types of electric furnaces are on the market at the present time, and a number of these have been especially designed for the melting of nonferrous metals and alloys, particularly brass. No furnace has been designed especially for aluminum and its light alloys, although a number of the standard electric furnaces have been used either experimentally or commercially for this purpose.

The idea has been held by some that a superior quality of metal would result from electric-furnace melting, but the electric furnace is to be regarded rather as a melting medium for metal rather than an appliance to convert poor melting stock into material of better grade. It may be stated that the electric furnace has been advocated by some on the ground that melting in a reducing atmosphere which can be obtained in all-arc and granular-resistor furnaces, would make it especially applicable for aluminum, but there are no actual data available in support of this contention.

The Baily granular-resistor furnace was the type first used commercially in 1918 for melting aluminum and its alloys. The 500-kilowatt furnace at the Massena, N. Y., plant of the Aluminum Company of America was the first installation, although the tilting type of this furnace had been tried experimentally for alloys before this time. Two resistor troughs made of refractory material and filled with resistor carbon or graphite are supported on brick piers. Electric current is sent through the resistor troughs, contact being made through copper terminals at the ends, and the heat generated in the trough is radiated largely to the furnace roof and then reflected down upon the hearth.

The Baily tilting resistor furnace is employed in a few foundries for melting aluminum alloys. The standard 105 kilowatt furnace consists of a cylindrical steel shell mounted on trunnions, and fitted with mechanism so that it may be tilted by hand. The Detroit indirect-arc rocking electric furnace has been used commercially for melting aluminum alloys in foundry practice. The General Electric type electric furnace is used by the General Electric Co. at several of its plants for melting aluminum and

*Anon., Melting Scrap Aluminum, *Metal Ind.*, vol. 3, 1905, p. 69.

**Barnes, E. A., Nonferrous Foundry Economics and Refinements, *Trans.*, Am. Inst. of Metals, vol. 5, 1911, pp. 90-113.

***Rhodin, J. G. A., Aluminum and Its Alloys in Engineering, *The Engineer*, vol. 131, 1921, pp. 488-489; 501; 531-532; 539; 586-588; 622-623; 635-636; 659-660.

Table II

Fuel Consumption in Melting No. 12 Alloy

Type of furnace	Fuel burned	Average weight of heat charged, pounds	Amount of fuel required to melt 100 pounds of alloy	Cost of fuel per 100 pounds of metal melted*	Approximate furnace efficiency, per cent†
Stationary crucible	Oil	100	10.0 gal.	$0.80	3.5
Stationary crucible	Oil	60	15.0 gal.	1.20	2.3
Stationary iron pot	Oil	300	1.25 gal.	0.10	28.0
Stationary iron pot	Oil	100	5.0 gal.	0.40	7.0
Stationary iron pot	Oil	250	3.75 gal.	0.13	9.3
Stationary iron pot	Natural gas	100	1000 cu. ft.	0.40	5.7
Tilting iron pot	Oil	200	5.0 gal.	0.40	7.0
Open-flame pear-shaped	Natural gas	200	450 cu. ft.	0.18	12.7
Open-flame pear-shaped	Oil	300	2.0 gal.	0.16	17.5
Pit	Coke	200	170 pounds	0.55	2.3
Pit	Coke	60	100 pounds	0.33	4.0
Pit	Coke	50	200 pounds	0.66	2.0
Pit	Coke	80	50 pounds	0.16	8.0
Pit	Coke	60	100 pounds	0.33	4.0
Pit	Coke	60	100 pounds	0.33	4.0
Pit	Anthracite coal	60	75 pounds	0.30	5.3

*On the basis of the following assumed costs for the different fuels: Oil, $0.48 per gal.; natural gas, $0.40 per 1000 cu. ft.; city gas, $0.80 per 1000 cu. ft.; coke, $6.50 per ton; and anthracite coal, $8.00 per ton.

†On the basis of the following approximate quantities of the different fuels required for melting 100 pounds of alloy: Oil, 0.35 gal.; natural gas, 57 cu. ft.; city gas, 86 cu. ft.; coke, 4 pounds; and anthracite coal, 4 pounds.

its alloys. A few other electric furnaces have been used experimentally or commercially for melting aluminum alloys, of which the Rennerfelt stationary indirect-arc type has been employed for the preparation of so-called *hardners*.

The Booth indirect-arc rotating furnace is similar in general construction and principle to other indirect-arc types, and it may be used for melting aluminum and its alloys. This furnace is built so as to rotate completely rather than rock.

Examine Conditions at Foundries

In carrying out the investigation of melting practice reported here, actual conditions at various plants were examined. This was accomplished by sending out a questionnaire to all plants known to melt aluminum and its light alloys; by studying existing melting records, gathered from a number of representative plants; and by making visits to many plants. Sixty plants replied to the questionnaire with data from their records. However these included the representative companies, and the following data given may be taken as representing average practice in the United States. Most of the information supplied in answer to the questionnaire refers to the melting of light aluminum alloys in foundry practice. A summary of the data furnished by plants is given in the following:

Sixteen of the 60 plants reported the use of stationary iron-pot furnaces, while 2 used tilting iron-pot furnaces. Two used tilting crucible furnaces, and 19 had stationary crucible furnaces. Pit furnaces were reported in operation at 29 plants, but it should be remembered that this type is generally used in jobbing shops and in small foundries devoted principally to brass and bronze. Six plants reported having pear-shaped open-flame tilting furnaces and one plant a barrel-shaped open-flame furnace. The use of reverberatory furnaces was reported by three plants, and a similar number operated electric furnaces of different types. Omitting here the pit furnaces where a plumbago crucible is used for melting, it may be said on the basis of the information furnished that the stationary iron-pot furnace and the stationary crucible furnace are the most favored for melting light aluminum alloys. Where the capacity of the plant is large, and the output of castings is regular, then the reverberatory, barrel-shaped open-flame, and electric furnaces are preferred by many foundrymen, i.e., a single furnace of large capacity. When given, the usual standard furnaces on the market were named.

Necessarily the size and capacity of the furnaces employed varies considerably. It may be taken as a general dictum in commercial practice that when a furnace of given capacity is once installed, additional output is taken care of by putting in furnaces of similar size. However, in general, the tendency in large plants in recent years has been toward the use of furnaces of large capacity.

Larger Pots Used

Considering first the case of the stationary iron-pot furnaces, the capacity of these was reported as from 100 to 400 pounds for the circular pots, and from 600 to 1200 pounds for the rectangular pots. Tne former are used more commonly, and only a few foundries employ the others. The capacities are expressed in terms of the alloy containing about 92 per cent aluminum and 8 per cent copper. The round pot holding 300 pounds is a common size; such a pot may be 20 inches in diameter and 16 inches deep. A bowl-shaped pot 18 inches in diameter and 18 inches deep is another common size; this holds 300 pounds of No. 12 alloy. Rectangular pots are generally of much greater capacity than the round ones. A typical size is 16 inches wide by 37 inches long by 26 inches deep, with a capacity of 1000 to 1200 pounds of No. 12 alloy. In the case of tilting iron-pot furnaces, much larger pots generally are used than in the stationary furnace, although the employment of 100-pound capacity pots is reported. However, pots holding 400 or 600 pounds usually are used. These may be bowl-shaped or of a more cylindrical shape.

Table III

Data on Furnace Operation

Type of furnace	Fuel used	Number of furnaces handled per furnace tender	Metal melted per furnace tender per hour, pounds	Metal melted per furnace tender per day, pounds
Stationary crucible	Natural gas	2	200	1800
Stationary crucible	Oil and gas	3	110	990
Stationary crucible	Oil	1–3	120	1080
Stationary crucible	Oil	2–3	200	1800
Stationary crucible	Oil	3	200	1800
Pit	Anthracite	6	900	5400
Pit	Coal and Coke	5	333	3000
Pit	Coke	1	42	375
Pit	Coke	4	240	2160
Pit	Coke	3	37–108	330–975
Pit	Coke	8	90	810
Pit	Coke	3	200	1800
Pit	Coke	7	544	4900
Iron pot	City gas	1	100	800
Iron pot	Natural gas	3	900	8100
Iron pot	Blue water-gas	8	1500–2400	13,500–21,600
Iron pot	Oil and gas	3	187	1680
Iron pot	Oil	3	900	8100
Iron pot	Oil	1	300	2700
Iron pot*	Oil	4	150	1350
Iron pot*	Oil	2–3	100	900
Open-flame	Natural gas	1	200	1800
Open-flame	Oil	1	200	1800
Open-flame	Oil	2	600	5400
Open-flame	Oil	2	400	3600

*Tilting iron-pot furnaces; the others mentioned are stationary.

Stationary crucible furnaces are generally in small units, and such furnaces are usually found in small foundries. No instance has been reported or has been observed of an installation of a battery of several such furnaces. Capacities vary greatly; Nos. 25 to 150 crucibles were reported, of which the most common sizes were Nos. 60 and 90. In the majority of furnaces, crucibles of various capacities may be used, but this is not standard practice; a definite size of crucible is employed in a given foundry, and the same size for charges of different weights. For practical purposes, and considering that the crucible is not normally filled with the alloy, the capacity in pounds of No. 12 alloy may be taken as equivalent to the number of the crucible. The operating capacities of No. 60 and No. 90 crucibles may be regarded as 60 and 90 pounds, respectively.

Tilting crucible furnaces of the same average sizes as the stationary furnaces mentioned here were reported. In regard to pit furnaces using a crucible, the usual sizes employed in brass shops were reported. Thus, No. 40 to 400 crucibles were stated to be in use, No. 60 and 80 being the most common.

Reverberatory Furnaces Large

The pear-shaped open-flame furnaces are generally rather small when used in foundry practice for No. 12 alloy in contradistinction to some of the fairly large furnaces of the same type employed in brass practice. The furnace having a diameter of 42 inches, and taking a 200-pound charge, was the one most favored. The reverberatory furnaces reported were large units holding 2000, 3000 and 4000 pounds of No. 12 alloy. The large barrel-shaped open-flame furnace in one plant has an operating capacity of 2000 pounds, and is 5 feet in diameter and 10 feet long.

The following electric furnaces were reported: Baily resistor, hearth capacity of 600 pounds; Detroit indirect-arc rocking furnace, capacity 700 pounds; and General Electric smothered-arc furnaces, capacity 500 pounds. Other firms known to use electric furnaces did not report.

A variety of linings were reported, but the one most commonly used is firebrick, irrespective of the type of furnace. In the stationary iron-pot furnace, the iron furnace shell is generally lined with an ordinary good grade of firebrick, one course, 4 inches thick. Extreme limits of 2.5 to 4.5 inches were reported for firebrick linings in these furnaces. The use of silica brick, 4 inches thick, was reported by one plant. In another installation, the iron shell of the furnace was lined with one course of 4-inch firebrick, which was covered by a thin layer of carborundum firesand. Another plant reported a 3-inch thick lining of a commercial high temperature cement, and the outside surface of the iron pots was covered with a layer of the same material. The use of linings or washes on the inside of iron pots was not reported, although it is known that a few foundries practice this to some extent.

Generally speaking, the stationary iron-pot furnace is built by simply lining a suitable iron shell with a layer of standard firebrick, 4 inches thick, and the pots are set in from an opening at the top. In the case of tilting iron-pot furnaces, which are normally circular in shape, a cylindrical iron shell is lined with a 4-inch layer of standard firebrick.

Stationary and tilting crucible furnaces are built mostly with a 4-inch lining of firebrick inside the furnace shell. Linings from 3 to 6 inches thick were reported. One firm uses a 4.5-inch firebrick lining covered with a thin layer of high-temperature cement in a stationary crucible furnace.

In the majority of installations of pit furnaces used for aluminum alloys in foundry practice it was reported that a 4-inch firebrick lining was used, but linings of this material from 2 to 5 inches are also used. Most of the egg-shaped open-flame tilting furnaces were lined with carborundum firesand. However, it is known that firebrick is also used in these furnaces. One firm uses a 4-inch firebrick lining. When carborundum firesand is used, the lining is from 2 to 4 inches thick. One firm uses a rammed ganister-clay lining, 3 inches thick. The reverberatory furnaces employed were all lined with standard firebrick. Of the three electric furnaces, one, a Baily granular resistor furnace, was lined with 4-inch firebrick; another, a General Electric smothered-arc furnace was lined with carborundum brick on the hearth and with firebrick on the sides; and the third furnace, a Detroit indirect-arc rocking furnace, was lined with corundite brick. Various other linings are known to have been used in electric furnaces operating on aluminum alloys.

Furnace Covers

In the majority of iron-pot furnaces, operated as single units, the foundries reported the use of a dome-shaped cast-iron cover about 1 inch thick. On the other hand, where stationary iron-pot furnaces are run as a battery, covers are not generally employed, although one firm uses them in such an installation. Covers are used on tilting iron-pot furnaces, but these are generally run open. For stationary and tilting crucible furnaces, cast-iron, firebrick, and molded-clay covers were reported. Firebrick and clay covers are built by setting bricks or clay in a thin iron shell, leaving a small hole in the center for the escape of gases. In some of these covers there is no hole provided.

On pit furnaces, cast-iron and refractory-lined covers are in use; the former are usually dome-shaped and the latter flat. The charging door on the pear-shaped open-flame furnaces generally is lined with refractory material and kept shut so that the exit gases escape through the pouring spout.

Most of the stationary iron-pot furnaces are fired by oil, fuel oil being most commonly used, but crude oil and distillate also were reported. Both natural and illuminating (city) gas is burned in these furnaces, the latter rarely. One plant uses blue water gas. Most of the furnaces were equipped to burn both oil and gas. Coke was the common fuel for pit furnaces, while anthracite and bituminous coal were reported by a number of plants.

Prevention of Oxidation

Are iron-pot furnaces run with closed covers or open? Of the plants answering the question as to what precautions are observed to prevent dross losses and oxidation of the metal, about half stated that no precautions were observed, while the remainder said that certain attempts were made to hold the melting losses low. Several plants reported that a thin layer of charcoal was spread on top of the charge to prevent oxidation. One firm uses a mixture of sodium chloride and calcium fluoride for this purpose; while another employs a mixture of 15 parts sodium chloride and 1 part zinc chloride. Other firms use zinc chloride alone. Several foundries considered that the most effective way of reducing oxidation was to melt at as low a temperature as possible; others referring to stationary crucible furnaces and to pear-shaped open-flame furnaces used a reducing flame for this purpose. When melting in pit furnaces, several plants use covers on the crucibles.

Replying to a question regarding the air pressure used at the burner, most of the plants reported the use of low pressure, varying from 1 to 18 ounces, and depending upon the type of burner. The use of high-pressure air was reported by a few plants. No firms reported the use of oil atomized by steam. Oil pressures varied from 5 to 60 pounds at the burner, with 30 to 40 pounds as common practice.

Oils varying from 24 to 38 degrees Baume were reported, with 28 to 30 degrees an average grade. One plant uses kerosene, but most plants burning oil use the so-called fuel oil. Only a few firms had figures available for the

calorific value of their oil; the majority, however, were burning an oil of about 19,000 B.t.u. per pound, or 145,000 B.t.u. per gallon. In the majority of installations of gas-fired furnaces low-pressure air was used at the burner, 1 to 4 ounces being common. Two installations used air at 2 pounds pressure. Gas pressures of 6 ounces to 9 pounds were reported. Most of the firms using gas reported the use of natural gas; two plants stated that illuminating (city) gas was employed; and one firm burned blue water gas. Few plants had any data as to the calorific value of their gas, and those that did report gave values which averaged about 1000 B.t.u. per cubic foot for natural gas and 570 B.t.u. for illuminating gas. The plant using blue water gas stated that its fuel had a calorific value of 300 B.t.u.

Table II, comparing fuel consumption when melting No. 12 alloy in different furnaces, has been constructed from the data as reported. These data are calculated on the basis of a 9-hour working day, melting No. 12 and related alloys.

The number of furnaces handled per furnace tender has a marked effect on the cost, therefore the data given in Table III are of interest. The figures given for the quantity of metal melted per furnace tender per hour are actual figures reported.

The compositions of the charge to make No. 12 alloy vary widely. Most of the foundries reported that the charge consisted of primary aluminum pig plus 50:50 copper-aluminum alloy plus No. 12 foundry scrap in varying proportions. Several plants use primary No. 12 pig plus No. 12 foundry scrap. Two plants stated that borings were used occasionally, but they regarded their employment as highly unsatisfactory. Seven plants used borings regularly; while the remainder used none. As a general rule, in foundries connected with manufacturing plants, and in the case of foundries that allow a return value for scrap and borings, all borings are either sold in the open market, sent to a smelter for remelting on toll, or else run down into pig in the foundry. On the basis of the replies, it may be said that where borings are used in the charges the melting loss is substantially greater in all types of furnaces than where the charge is made up without borings.

The following materials were reported as being employed as fluxes: Zinc chloride, ammonium chloride (salammoniac), a mixture of zinc chloride and ammonium chloride, borax, a mixture of sodium chloride and borax, and a mixture of sodium chloride and calcium fluoride. Zinc chloride was the most popular flux, and the other fluxes were reported singly by different foundries, with the exception of ammonium chloride, which was used by several plants. A number of foundries use no flux, and from the replies there appeared to be a tendency among foundrymen to abandon the use of fluxes in melting aluminum alloys. In the case of zinc chloride, the quantities used varied from about 0.10 to 8 ounces per 100 pounds, with a general tendency to use small lots, say about 1 ounce to 100 pounds of metal.

Most of the plants said that all dross and skimmings were sold to scrap-metal dealers or to other buyers in the open market. Several firms remelt this waste, recover the metal, and then sell the residue. One plant screens the mixed material to recover metal and sells the aluminum oxide.

How and Why in Brass Founding

By Charles Vickers

Large Casting Comes Out Same as Pattern

We enclose a sketch of a large manganese bronze casting recently cast which presents a phenomenon for which we are unable to account. Instead of contracting after the manner of metals it remained the full size of the pattern. The casting is a bed plate for the main engine on a submarine and the pattern was made with the usual 3/16-inch to the foot contraction allowance and designed in such a manner as to leave nearly all its own cores in green sand. The five main bearings were cast down. The casting apparently was all that it should be until it was dimensioned and then it was discovered that it was exactly the same size as the pattern. The mold was poured about 3 o'clock in the afternoon and was not disturbed until the following day when the cope was removed. The drag, containing the casting was left to cool an additional 24 hours. We should like to learn if this treatment affected the contraction in any manner. Would contraction have been facilitated if the sand had been loosened shortly after the casting it was poured?

The usual patternmaker's allowance for shrinkage in the case of manganese bronze is ¼-inch per foot, but in the case of large castings this can be shaded and 3/16-inch would be correct. If the alloy used for this particular casting has no shrinkage it is a remarkable metal and the fact should be known, therefore, it would be advisable for the satisfaction of all concerned carefully to determine this point.

We suggest you mold and cast a 1-inch square bar exactly 12 inches long and allow it to cool in the sand, then measure the contraction. If the bronze is sound and not filled with gas holes, the bar will contract normally, and so far as we know, no power on earth can prevent it from occuring naturally. Evidently there must be some explanation of the fact the casting did not contract normally. It would not be an easy matter to rap a pattern nearly 9 feet in length, sufficiently before removing it from the mold, to enlarge the latter enough to compensate for the shrinkage; but as the possibility exists, it will do no harm to take it into consideration. If the mold was rammed hard enough to successfully oppose the natural tendency of the metal to contract in size, the casting would have cracked in one or more places. The casting is not cracked and therefore the only reasonable assumption is the metal must have been under sufficient pressure to expand the mold more than usual. This feature presents a possibility by the fact that the mold was made of green sand. All large castings would be over size if the patterns were made with the same shrinkage as that provided for smaller castings of the same alloy. Small castings of manganese bronze require a contraction allowance of 4/16-inch per foot. On the bed plate an allowance was made for expansion due to the weight and pressure of the metal and the pattern was allowed only 3/16-inch per foot for shrinkage. The available evidence would seem to indicate the green sand mold did not hold the casting to size.

Extensive internal stresses may exist in the casting, and if so it will fail by cracking in service. As a result of work done by the bureau of standards it has been shown that such stresses in manganese bronze castings can be entirely relieved by annealing for 7 hours

at 750 degrees Fahr., without affecting the physical properties of the metal. Should it be possible in the case of this casting to anneal it overnight at a low temperature around 500 degrees Fahr., it would do no harm and make certain the internal stresses were relieved. Allowing the casting to cool in the mold would not effect the shrinkage of the metal in any manner. It would weaken the casting if made of aluminum bronze, but with manganese bronze appears to have no harmful effect.

Eliminating Blowholes in Bronze Sleeves

We are experiencing trouble in making bronze sleeves for propeller shafts. These sleeves are about five feet long, seven inches outside diameter and five inches inside diameter. Our castings are full of blowholes, which are objectionable because the water will leak through and attack the steel shafts. We would like to learn of an alloy suitable for such castings, how to make the mold, gate, and the pouring temperature.

Two ways of molding and casting such plungers are suggested; one with the mold vertical and the other with the mold horizontal. Both methods will produce sound castings. Use a free venting sand; fine bench sand is not suitable. Black the molds and skin-dry them. One manufacturer poured bushings over 2000 pounds weight; 14 inches diameter, horizontally with the gate on the joint at one end and obtained satisfactory castings. Another poured plungers, about the size of the one mentioned in the query, upright carrying the gate to the parting of cheek a few inches above the bottom of the mold, also cutting in another gate at the top of mold and feeding with risers 3 inches in diameter and 10 inches long, which were churned after pouring. The main thing to be careful about in the mold is to have it warm and dry and of such a structure that the gases can come away freely through the sand, permitting the metal to lay against the mold surfaces without the least simmering or spitting. Melt the metal under charcoal, and when down cover with floor sand while it is getting hot. An alloy of the following composition will be satisfactory:

Bronze Sleeve Alloy

	Per cent
Copper	88.00
Phosphor copper	1.00
Tin	9.50
Lead	2.50

If it is preferred to add about 2 per cent zinc, reduce the phosphor copper to 2 ounces per hundred pounds and if crucibles are used for melting, place the phosphor copper in the bottom before the charge of copper is placed therein. Be careful *not* to pour the metal at such a temperature that it appears dull and sluggish, and do not forget the risers or feeders. Shake out the castings hot, below a red heat, and clean them with a spade.

While the vertical method of pouring has given good results, personally I prefer the horizontal, and would feed the castings with a 3-inch riser, built up six inches higher than the top of the cope. After pouring until the sprue is filled, cover the liquid metal with molding sand, bed on a weight and gently dribble hot metal into the riser until full. The riser must be brought up as slowly as possible, for that is the way to feed bronze. The mold must be strongly bound with clamps so there will be no *giving* when the pressure comes upon it, due to filling up the riser. A facing in the old days considered ideal was one part silica sand, one of coarse molding sand, and one of fine molding sand, bonded with sour beer, but some other bond will now have to be used, and beware of molasses containing sulphur dioxide. Use flour instead.

Precautions Taken in Casting Flat Plate

We have difficulty casting flat aluminum plates ranging from 1/4 to 1/2 inch in thickness. The surface of the plates shows rough seams which are mostly in the drag and it looks as if the sand had heaved up or contorted. The seams are not regular and do not always appear in the same place. Some of the plates have a regular surface. As we cannot determine the cause of these seams we are asking your help and desire to know how these plates should be cast to insure smooth, level castings.

From the description of the difficulty it looks as if the molding was at fault, and we suggest a careful scrutiny of all the operations involved in the production of the molds. First, are the bottom boards sound, strong and reasonably level? Second, is the sand rammed unusually hard, or it is on the wet side? A flat, straight plate is not as simple a molding proposition as it looks; some plates in certain alloys have to be cast on edge, and not flat, to get a high percentage of good castings. In the case of an aluminum plate this should not be necessary but the drag of the mold should be made so the gases can easily escape through the sand and not have to pass through the metal or failing that tear up the mold. Face the patterns, on the drag side particularly, with fine sand to get smooth castings, and back up with a free venting sand, worked on the dry side, and rammed for aluminum, rather soft. Do not bed the bottom boards onto the flask, airtight, but tack little strips of wood ¼-inch thick on the edge of the drag at intervals, so as to leave spaces between for the gases to escape. Venting with a knitting needle to within a quarter inch of the pattern should be resorted to provided the difficulty continues but it is better to avoid venting when possible.

Running Stick Brass

We have had difficulty running stick brass from 1.5 to 2 inches diameter and 12 inches long, using a mixture consisting of copper, 86 per cent; tin, 10 per cent; zinc, 3 per cent and lead, 1 per cent. We cast these upright, but find the metal segregates and shows a scale of segregated metal about half way to the top of the bar. It also gives a steel color, and dirty and porous castings. The castings are gated at the bottom and the metal rises in the molds into a riser placed on top of the bars. Would the zinc in the metal, cause the dirt spots or porous castings, or is the gating at fault?

It is a peculiarity of cast copper, or of bronze, brass or composition metal, that it is more difficult to get sound castings in the shape of solid cylindrical rods, when poured vertically than when poured horizontally. This is due to the difficulty of filling up the pipe that forms as a result of shrinkage, therefore, while some may prefer to cast such shapes vertically, and often appear to do so satisfactorily, if a careful note is kept of production losses it will be found cheaper to cast them horizontally. In other words it is better to get the pipe and the segregated rich copper-tin alloy in the sprue than in the castings. Also, the sand must be less damp for vertical pouring than for horizontal pouring and if this is not observed the molds will be likely to cut and the castings be dirty. The zinc has nothing to do with the difficulty as 3 per cent zinc is not excessive. We believe less segregation will occur if the tin is reduced 1 per cent, and is replaced by copper. We suggest these bars be cast horizontally; a flask 12 inches wide will take three 2-inch bars easily, laid side by side, and they can be gated on the ends, and the metal shot into the molds. Make a round gate into the bars, about a half inch smaller in diameter than the bars. Have a shallow runner in the drag, but have it 1.5 inches high in the cope. Put the sprue directly on top of this runner. Have it 2.5 inches in diameter, and build it up with a sand head to 4 inches above the top of the castings. Pour on the level, and let castings cool below red, then shake out and hit the sprue away from the castings and break off the gate. Use 2 ounces of phosphor copper in the bottom of the crucibles, and there will be no further trouble.

THE FOUNDRY

Registered U. S. Patent Office

A semimonthly journal devoted to all branches of the foundry trade

Published by
THE PENTON PUBLISHING CO., CLEVELAND, O.

BRANCH OFFICES

BOSTON.....476 Old South Bldg.
CHICAGO.....1147 People's Gas Bldg.
CINCINNATI.....501-505 Commercial Tribune Bldg.
NEW YORK.....2203-2206 St. Paul Bldg.
PITTSBURGH.....2148-49 Oliver Bldg.
SAN FRANCISCO.....675 Monadnock Bldg.
WASHINGTON, D. C.....84 Home Life Bldg.

FOREIGN OFFICES

BIRMINGHAM, ENGLAND.....Prince's Chambers
LONDON, ENGLAND.2-3 Caxton House, Westminster, S.W. 1
PARIS, FRANCE.....224 Rue de Rivoli
Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico.....$3.00 a year
Canada.....$4.00 a year
Great Britain and other Foreign Countries.....$4.00 a year
Single Copies.....25 cents
Copies published three months or more previous to date of current issue, 50 cents each.

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 1st and 15th of the month preceding date of publication.

Member, the Audit Bureau of Circulations, Associated Business Papers, Inc., and National Publishers Association

Entered at the Post Office at Cleveland as Second Class Matter

Copyright 1922 by The Penton Publishing Co.

Contents

	Page
Shop Has Diversity of Methods	895
Book Review	899
Opens Branch Offices	899
Modern Foundries of Central Europe—I	900
Bill Renews His Youth with Music	906
Tests Ground Coat Enamel	908
Opens Engineering Office	908
Sell Malleable Company	908
French Hold Sessions at Nancy	909
Patterns Are Bedded in the Floor	911
Will Produce Fluorspar	914
Maine Foundry Moves	914
Gives Data on Heating	914
Blast Pressure for Cupola	914
Investigates Alloys of Brass and Bronze	914
Converter Makes Better Steel	915
Book Review	917
Hard Iron Balls Present Pouring Problems	918
Aluminum Melting Practice—V	919
How and Why in Brass Founding	924
Large Casting Comes Out Same as Pattern	924
Eliminating Blowholes in Bronze Sleeves	925
Precautions Taken in Casting Flat Plate	925
Running Stick Brass	925
The Good Old Days Have Gone—Good!	926
Trade Outlook in the Foundry Industry	927
Comings and Goings of Foundrymen	928
A. F. A. to Hold Meeting in Cleveland	928
Pig Iron Dealers Form Association	929
French Society Tenders 1923 Invitation	929
Discuss Multiple Melting	929
Presents Paper on Waste	929
Form New Technical Society in England	929
Indiana Foundrymen Will Meet in Lafayette	929
American Foundryman Is Tendered Dinner	930
New England Association Hears About Boys	930
Ohio Foundrymen Meet in December	930
Elected by Association	930
James F. Sords Dies	930
Returns Have Been Slow	930
Steel Men on Committee	930
Discusses Cupola Practice	931
New Foundrymen's Society	931
Creates Permanent Board	931
Obituary	931
Chain Block Is Equipped with Motor Drive	931
French Jarring Machine Compact and Rapid	932
Slide Rule to Calculate Furnace Additions	932
Equipment Demand Is Varied	933
What the Foundries Are Doing	934
New Trade Publications	934

The Good Old Days Are Gone—Good!

EVERYONE at some time meets the individual who compares the glorious past with the decadent present. Time has the merit of exaggerating perspective. Witness your own imaginings as to the great breadth and girth of the knights of old and then wander through some museum and compare your mental pictures of those who rode abroad in errantry with the moderate sized steel shells which encased their forms.

All honor to the foundryman of generations past. To Cellini the genius of ancient times, to the sturdy masters who cast the guns for the armies of McClellan, Grant and Lee, and to those craftsmen who a generation ago worked wonders with loam and sand all credit is due for the present status of the foundry industry. They all wrought under handicaps unknown to the present generation. They were pioneers as truly as were those who in covered wagon, rifle in hand, pushed backward the western frontier. The foundryman of a generation ago did not have available modern molding equipment, high temperature furnaces, chemistry, or a scientific knowledge of his basic materials. Neverthless, the old-time maker of castings, no doubt, had placed before him by his forebears the picture of perfection which *his* previous generation had to offer. He probably heard much of the decadence of workmanship. The lack of interest, industry and ability which characterized his generation probably was painted as black as his instructor's language would permit, for such is always the way of times which are passing.

Today, the same situation holds true. The molder who made large ship castings on Tyne-side and who now supervises the work of some dock-yard foundry along the Lakes truthfully can point to his superiority in many phases of workmanship due to the technical skill of his earlier associates. His mention of the shortcomings of some of the present generation of molders is justified and doubtless his indictment of the spirit of many who are learning the trade is sustained. However, when the past is held up for a shining mark, only its merits should be emulated. Its many failings should be avoided in the light of present day practice.

In these days of impending labor shortage, when so much attention is directed to the need for new blood, and effort is being made to attract the right sort of young men into the foundry, many of the working conditions prevailing even today, might be corrected with profit. The management which permits men to work in ill-lighted, poorly ventilated and unheated shops cannot justify its position by pointing to the splendid castings made under even worse conditions in the past. The workmen who accepted such conditions as part of their lot lived in unheated or poorly heated houses, had no artificial light except a tallow dip or kerosene lamp and classified all ventilation under the general heading, *a draft*. Their every day existence offered no contrast to their working conditions.

Today living standards have changed. Better domestic conditions lead workmen to expect common comforts in their places of employment. The foundry industry must compete keenly with other lines of manufacture for its labor supply, and in doing so it must expect to provide, so far as is possible, against unfavorable contrasting of working conditions as they are found in other trades.

Trade Outlook in the Foundry Industry

BUSINESS conditions in the foundry industry continue to support the forecasts of a busy fall and winter. Activity is maintained in practically all lines, while an increase is noted in the malleable and steel railway specialty shops and among the stove and furnace plants. Some heavy steel foundries are operating at a higher rate than at any time during the war. One high grade steel foundry in northern Ohio recently closed an order which will entail steady production at a high rate for six months. Transportation obstacles have been lessened, but are not as yet entirely relieved.

Buy Iron Cautiously

During the past two weeks a growing reluctance to purchase iron has been noted. Such always is the tendency on a falling market and with improved shipping conditions many plants have come to depend upon hand to mouth purchases of materials. Stocks of iron both on the yards of the furnaces and in the stock piles of the melters are light. Further, but little iron has been contracted for next year. This condition governs throughout the country. October production figures compiled by the *Iron Trade Review* establish the largest gain of any month since March, 1918. The total production of iron was 2,629,655 tons, which compared to the September output of 2,024,008 tons shows a gain of 605,647 tons. Last month's total was the largest since December, 1920. A net gain of 29 furnaces is shown on Oct. 31. Merchant iron in October reached 502,231 tons which is a gain of 148,627 tons over the September figure of 353,604 tons. The daily average production was 16,201 tons compared with 11,786 tons per day in September. This shows an advance of 4415 tons per day or 37.5 per cent. Ten merchant stacks were blown in during October and two were blown out giving a net gain of eight furnaces.

Prices of Raw Material for Foundry Use

CORRECTED TO NOV. 9

Iron		Scrap	
No. 2 Foundry, Valley	$29.00 to 30.00	Heavy melting steel, Valley	$21.00 to 21.50
No. 2 Southern, Birmingham	25.00 to 27.00	Heavy melting steel, Pitts.	20.50 to 21.00
No. 2 Foundry, Chicago	31.00	Heavy melting steel, Chicago	17.50 to 18.00
No. 2 Foundry, Philadelphia	31.13 to 31.64	Stove plate, Chicago	19.00 to 19.50
No. 2 Foundry, Buffalo	28.00 to 29.00	No. 1 machy. cast, Chicago	23.00 to 23.50
Basic, Valley	29.00	No. 1 cast, Philadelphia	23.00 to 25.00
Basic, Buffalo	30.00	No. 1 cast, Birmingham	19.00 to 21.00
Malleable, Chicago	31.00	No. 1 cast, Buffalo	21.00 to 22.00
Malleable, Buffalo	28.00 to 29.00	Car wheels, iron, Pittsburgh	23.50 to 24.00
Coke		Car wheels, iron, Chicago	25.50 to 26.00
Connellsville foundry, coke	$9.00 to 10.00	Railroad malleable, Chicago	24.00 to 24.50
Wise county foundry, coke	11.00 to 12.00	Agricultural mal., Chicago	24.00 to 24.50
		Malleable, Buffalo	22.00 to 23.00

Car Orders Accelerated

Purchases of railway equipment, particularly cars, have continued to expand steadily. Cars ordered in October reached 12,700 bringing the total for the year to 138,000, or six times the total number purchased last year. Inquiries are extant for approximately 50,000 cars and deliveries are sought by the first quarter of 1923. Repair orders also are growing in volume. In consequence foundries specializing in railway work are engaged to capacity and the effect is noted in the rate of production in malleable and steel castings. Locomotive purchases for domestic use total 260 during October, while additional contracts for at least 100 units are expected during the present month. That this movement is by no means premature is demonstrated by the steady increase in car loadings and the shortages noted. During the week ending Oct. 21, the loadings totaled 1,003,759 cars compared to 964,811 for the corresponding week last year and 983,479 in the week ending Oct. 14. The highest total ever recorded is 1,018,500 cars and the figure has not gone over the million mark previously since October, 1920. The daily average shortage of cars in the week of Oct. 15 to 23 was 166,349 which sets a new high figure.

Stove Shops Active

With the approach of winter, stove, furnace and radiator foundries are becoming increasingly active. One manufacturer of stoves reports that his orders indicate that dealers have practically no reserve stocks, as the call for a wide variety of styles and sizes is general throughout his sales territory. Building activities have been continued throughout the fall. In Chicago permits increased 22.9 per cent in October over the total for September and showed a decided gain over October last year. Automobile production held up well during October, a preliminary estimate of the National Automobile Chamber of Commerce placing the output at approximately 244,000 cars or about 20 per cent ahead of the September total. Castings demand has decreased slightly during early November. A representative automobile cylinder manufacturer, specializing on passenger car castings has reduced his schedule to four days a week and anticipates only 15 days operation in December. However, the estimates for next year are said to be larger than for 1922 and orders are being placed for January delivery. Truck sales and closed car requirements continue to maintain a fair demand for castings from many foundries. Next year is expected to set a record for the sale of farm implements and contracts for castings are being placed with this in view. In the East, the machinery and textile manufacturing interests are furnishing a ready outlet for jobbing castings.

Brass Demand Steady

Plumbing goods and brass castings for miscellaneous building construction are unusually active for the time of year. Aluminum castings sales are stimulated by changes in automobile specifications and by the growth of interest in cast cooking utensils. Prices on nonferrous metals, based on New York quotations in the *Daily Metal Trade* of Nov. 9, follow: Casting copper, refinery, 13.40c; electrolytic copper, 13.87½c; Straits tin, 37.75c; lead, 7.10c to 7.15c; antimony, 6.55c to 6.60c; aluminum, No. 12 alloy, producers' price, 21.00c to 21.20c and open market, 19.00c. Zinc is 7.15c to 7.20c, E. St. Louis, Ill. Average monthly prices for October follow:

(New York Quotations)

Casting Copper	Electro. Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc St. Louis
13.45	13.922	36.69	34.66	6.78	20.50	6.86

Comings and Goings of Foundrymen

DR. PERCY Longmuir, Sheffield, England, has been appointed director of research of the British Cast Iron Research association and assumed his duties Nov. 1. Mr. Longmuir's activity in the industry dates from 1897 and his career as foundry apprentice, foreman, manager and finally director has brought him distinction in both the practical and scientific phases of the industry. He received his metallurgical training at Sheffield university, after which in May, 1902, he was awarded a Carnegie research scholarship by the Iron and Steel Institute which was renewed in 1903. He received the Carnegie Medal for research on the subject of the influence of varying casting temperatures on the properties of alloys. Later he engaged in research work at the National Physical Laboratory and the results of his investigations in collaboration with Sir Robert Hadfield and Prof. Carpenter were published in the report of the alloys research committee of the Institution of Mechanical Engineers. Dr. Longmuir then engaged as foundry consultant and was appointed examiner of metallurgy for Sheffield university. From 1909 to 1919 he was works manager at the Stocksbridge works of S. Fox & Co., Ltd. and at the present is technical director for H. Rossell & Co., Ltd., Sheffield. Dr. Longmuir was one of the founders of the Institution of British Foundrymen and was president in 1910 and again in 1911. Aside from his research and executive activities, Dr. Longmuir is keenly interested in training workmen and for some years has been a lecturer before employes in the Sheffield iron and steel industry.

W. R. Marvin has succeeded L. E. Woodsend as general manager of the Valley Foundry & Machine Works, Inc., Fresno, Cal.

Warren A. Ellsworth has accepted a position on the engineering staff of the Wheeling Mold & Foundry Co., Wheeling, W. Va.

Charles T. Bragg, formerly with the Michigan Smelting & Refining Co., Detroit, is now president and general manager of the Michigan Valve & Foundry Co. of the same city.

W. R. Haupt and C. A. Belanger have formed a partnership to engage in the production of bronze, brass and aluminum castings, patterns and matchplates under the title of the City Foundry Co., 1299 Broad street, Hartford, Conn.

Chas. F. Hermann, formerly manager Almont Mfg. Co., Almont, Mich., has accepted a position as foundry superintendent with Michigan Valve & Foundry Co., Detroit.

S. Griswold Flagg III, Stanley G. Flagg & Co., Philadelphia, was elected a director of the American Foundrymen's association at a recent meeting of the board of directors held in Chicago. He fills the vacancy created by the death of the late J. P. Pero.

DR. PERCY LONGMUIR

Samuel B. Myers of Dayton, O., formerly with the Utah Copper Co., has become associated with the foundry department of the Imperial Electric Co., Akron.

W. Russell Baird has taken charge of the foundry of the Vaughn Foundry Corp., Norwich, Conn., succeeding A. A. MacDiarmid who has gone to Kenogami, Ont., with the Price Bros. Co., Ltd.

E. S. Black, for 12 years with the American Manganese Steel Co. has become vice president of the Inland Engineering Co., Chicago, a producer of alloy steel castings. The company also does a general engineering business.

Carl D. Britton has retired as general manager of the Engman Matthews Range Co., Goshen, Ind. He has been succeeded by Ernest Pittman of Albany, N. Y., representing a committee, which recently assumed responsibility for operation of the plant.

W. R. Bean, Eastern Malleable Iron Co., Naugatuck, Conn., president of the American Foundrymen's association, 1920-21, was confirmed in his election as honorary member of the association at a recent meeting of the board of directors held in Chicago. This action follows his election to honorary membership at the closing session of the Rochester convention.

Felix P. Hammes, formerly assistant to J. F. Flynn, production manager of the D. J. Ryan Foundry Co., Ecorse, Mich., has been appointed to the position left vacant by the death of Mr. Flynn. Mr. Hammes, formerly with the Ecorse Foundry & Machine Co., joined the D. J. Ryan organization when the Ecorse plant was taken over in Feb. 1, 1919. Prior to his Ecorse experience Mr. Hammes was associated with the U. S. Glue Co., Milwaukee, in the capacity of assistant superintendent.

H. Jewson of Hobbies Ltd., East Dereham, Norfolk, elected senior vice president of the Institution of British Foundrymen at the Birmingham convention as reported in the July 1 issue of THE FOUNDRY, later on account of business considerations, resigned. The vacancy created by the resignation of Mr. Jewson has been filled by the election of Oliver Stubbs, former president of the institution, to the office. Mr. Stubbs now is busy organizing a local committee to handle the next convention which will be held in Manchester in June or July, 1923, instead of in Newcastle as formerly announced.

A. F. A. To Hold Meeting in Cleveland

Contrary to the plan of previous years, the next exhibition to be held in connection with the annual meeting of the American Foundrymen's association will be opened on Saturday instead of on Monday as heretofore. According to an announcement just made by C. E. Hoyt, secretary of the association, the annual meeting will be held in Cleveland Public Hall from April 28 to May 3. Saturday, April 28, will be known as "Cleveland Day" and will mark the opening of the exhibi-

tion. The opening session of the convention will be held Monday. The selection of Cleveland as the convention city by the convention committee was approved by the directors of the association Oct. 23.

At a meeting of the board of directors held in Chicago early in October reports of the secretary-treasurer, manager of exhibits, and of standing and special committees, were received. The retiring president, W. R. Bean of the Eastern Malleable Iron Co., Naugatuck, Conn., was elected to honorary membership. At the first meeting of the new board of directors at which C. R. Messinger, Sivyer Steel Casting Co., Milwaukee, presided, C. E. Hoyt was re-elected secretary-treasurer and R. E. Kennedy, University of Illinois, was named assistant secretary. R. A. Bull, S. T. Johnson, L. W. Olson and Fred Erb, together with the president, vice president and secretary will constitute the executive committee of the board for the coming year Mr. Hoyt also was elected manager of the department of exhibits, which position he has held for a number of years.

Pig Iron Dealers Form Association

Formation of the Iron Mongers association at Boston, recently, was the cause for considerable comment and friendly indignation on the part of the Tubal Cain chapter of the Iron Mongers Association of Philadelphia. This latter chapter claims to be the originator of the name *Iron Mongers Association* and insists that the Boston chapter recognize the Philadelphia chapter as the parent organization. After a good deal of controversy this has been definitely agreed to and the Boston chapter now will be known as the Puritan chapter of the Iron Mongers association. It is understood other chapters will be installed in different cities. The association is a social one among pig iron dealers and furnace interests.

French Society Tenders 1923 Invitation

An invitation to the American Foundrymen's association from the Association Technique de Fonderie of France to participate in an international convention and exhibit at Paris in September, 1923, was accepted and referred to the following committee: H. Cole Estep, European manager, *Iron Trade Review*, London, Chairman; Stanley G. Flagg Jr., Stanley G. Flagg & Co., Philadelphia, vice chairman; L. L. Anthes, Anthes Foundry Ltd., Toronto, Canada; G. H. Clamer, Ajax Metal Co., Philadelphia; A. O. Backert, Penton Publishing Co., Cleveland; and Franklin G. Smith, Osborn Mfg. Co., Cleveland. This committee will represent the American Foundrymen's association and will determine to what extent the association may take an active part in the proposed international convention. Stanley G. Flagg, III of Stanley G. Flagg & Co., Philadelphia was elected a director to fill the vacancy caused by the death of John P. Pero.

Discuss Multiple Melting

Frank W. Brooke, chief engineer for William Swindell & Bros., Pittsburgh, delivered an address on "The Multiple Melting of Steel and Gray Iron in the Foundry," November 11 before the Chicago Foundrymen's club. His lecture was illustrated by lantern slides. The December meeting of the club, December 9, will be devoted to an exhibit of nearly 100 samples of molding sand, physically analyzed by a new method devised by Eugene W. Smith of the Crane Co. foundries at Chicago. This exhibit and description of the method is the outcome of a long discussion of foundry sands carried on for several months by the Chicago Foundrymen's club.

Presents Paper on Waste

President A. J. G. Smout of the Birmingham Metallurgical society presented a paper on waste and inefficiency in the metal industry, at the inaugural meeting of the society, held in Birmingham, England, Oct. 4. Emphasis is laid in this paper on the vast amount which could be saved by watching details and eliminating all forms of waste in the foundry. A silver medal was presented to F. Johnson, retiring president, in recognition of his valuable work on behalf of the industry. L. F. Wharton, a student of the Birmingham technical school, received a bronze medal for the best thesis on foundry subjects, his paper dealing with 68:32 brass.

Form New Technical Society in England

A new technical society has been organized in Great Britain known as the West Yorkshire Metallurgical society. H. C. Dews, 7 Calder road, Ravensthorpe, Yorkshire, is president, and H. R. Pitt, Wakefield, Yorkshire, honorary secretary. The new society has been formed for the purpose of bringing about a more complete interchange of metallurgical information between engineers, superintendents, foremen, workers, etc., in the Yorkshire iron, steel and engineering district. The operations of the new society include such important iron and steel centers as Leeds, Bradford, Sheffield, etc.

A program of monthly meetings commencing Oct. 28, has been arranged. At the first meeting T. E. Hull, of J. Hopkinson & Co., Huddersfield, read a paper entitled "Growth and Deterioration of Cast Iron Through Repeated Heating." Other papers which are on the program for the winter include: "Aluminum," by Dr. Bramley, of the Technical college, Loughborough; "Ball Indentation Methods of Hardness Testing," by C. R. Groves, Technical college, Bradford; "Heat Treatment of Nonferrous Alloys," by Dr. F. C. Thompson, of Manchester University; and "Cast Iron," by E. Adamson, engineer, Sheffield, the latter paper to be presented at a joint meeting with the West Riding Branch of the Institution of British Foundrymen.

Indiana Foundrymen Will Meet in Lafayette

An organization meeting and conference of Indiana foundrymen will be held at Purdue University, Lafayette, Ind., Nov. 23 and 24. This meeting is called under direction of the engineering extension service of the university. The following program has been prepared to be presented during the two days:

THURSDAY AFTERNOON, NOV. 23

Foundry Conditions in Indiana, R. E. Wendt, instructor in foundry practice, Purdue University Lafayette.

The Layout and Design of a Modern Foundry, F. D. Chase, F. D. Chase Inc., Engineers, Chicago.

The Manufacture of Pig Iron, H. B. Northrup, Diamond Chain and Mfg. Co., Indianapolis.

The Manufacture of Malleable Iron, N. M. Waterbury, Link-Belt Co., Indianapolis.

THURSDAY EVENING

Team Work in Your Industry, A. J. Tuscany, secretary, Ohio State Foundrymen's association, Cleveland.

Round Table Discussion, led by A. J. Rumely, LaPorte Foundry and Furnace Co., LaPorte, Ind.

FRIDAY MORNING, NOV. 24

Warpage in Iron, J. F. Keller, heat specialist, engineering extension, Lafayette.

Cost Keeping, E. T. Runge, E. T. Runge Cost Co., Cleveland.

Metallurgy in the Foundry, J. H. Hopp, C. C. Kawin Co., foundry engineers, Chicago.

Why Research Pays, H. C. Peffer, head, school of chemical engineering, Lafayette.

FRIDAY AFTERNOON

A gray iron heat will be taken off by the students in foundry practice as a part of their regular work. Following an inspection of the shop and engineering laboratories will be made.

American Foundryman Is Tendered Dinner

David McLain, head of McLain's System, Milwaukee, who recently returned from a five months' trip through Great Britain and continental European countries was tendered a complimentary dinner at the Central Station hotel, Glasgow, on the evening of Oct. 13 by a number of prominent Scottish foundrymen. John Cameron was in the chair and the following toast list was honored: The King, proposed by the chair; The Foundry Trades, proposed by James K. Shanks, responded to by Bailie John King; Our Guest, proposed by John Cameron, response by David McLain; McLain Students was proposed by W. Mayer and responded to by Geo. Albert Ure. Songs were rendered by John More, William Shanks and John Wright. Other prominent foundrymen at the dinner were Thomas C. Cameron, Matt Riddell, D. M. King, Hugh Hodgart and Prof. Campion.

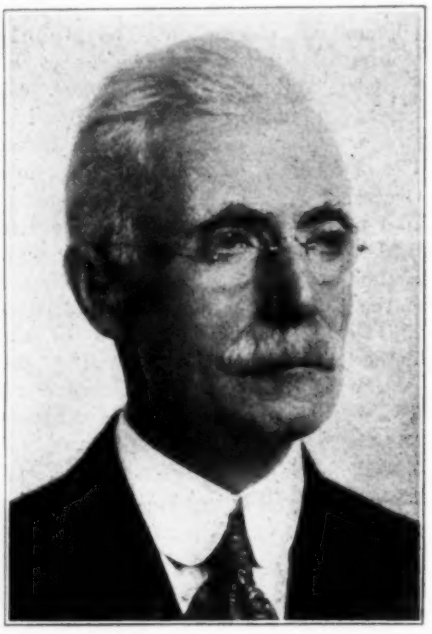
New England Association Hears About Boys

How to interest the American boy in the foundry industry and how to retain that interest, foster and develop it, was the subject of a talk delivered by Clifford B. Connelley, commissioner department of labor and industry, Harrisburg, Pa., before the New England Foundrymen's association at the regular monthly meeting Nov. 8, in the Exchange club, Boston. Mr. Connelley deplored the tendency among the growing generation of boys and young men to avoid any kind of work that involves wearing overalls or that hints even remotely at manual labor. As spenders both of time and money they were in a class by themselves, but as useful members of a community, willing and able to exchange service they were a lamentable failure. He admitted that the foundry as at present conducted in the majority of instances offers no inducement to intelligent boys and claimed that this is a phase of the question that merits the earnest consideration of the foundry owners and managers.

Ohio Foundrymen Meet in December

An interesting and educational program is being prepared by the Ohio State Foundrymen's association to occupy the attention of its members and visiting guests during the annual convention to be held at Middletown, O., Dec. 7 and 8. Thursday morning, Dec. 7, will be devoted to registration at the Manchester hotel. Luncheon will be served at 11 a. m. to be followed by a business session which is scheduled to fill the afternoon until 5:30. At 7:30 an informal dinner with special entertainment features will be provided.

Friday morning will be devoted to an inspection trip through the extensive works of the American Rolling Mills Co. and lunch will be served through the courtesy of that company at its dining room in the plant. In the afternoon automobiles will be provided to take the visitors to Cincinnati



JAMES F. SORDS

where special entertainment will be offered by the Cincinnati foundrymen. F. W. Huber, American Rolling Mills Co., Middletown, O., president of the Ohio association, is chairman of the committee on arrangements at Middletown, while L. B. Weber, Elmwood Castings Co., Cincinnati, past president of the association and G. W. Piehl, Wessling Brothers Foundry Co., Cincinnati, will have charge of the entertainment features in the latter city.

Elected by Association

The McFarland Foundry & Machine Co., Trenton, N. J., makers of cast chilled iron wire-drawing dies, etc., has been elected a member of the Philadelphia Foundrymen's association.

Cleveland offices of the Independent Pneumatic Tool Co., Chicago, have been moved from 1103 to 1204-5 Citizens' building, Cleveland.

James F. Sords Dies

James F. Sords, director and factory manager Allyne-Ryan Foundry Co., Cleveland, died at his home in that city, Oct. 20. Mr. Sords was associated with the foundry industry in some active capacity throughout his business life. He was born in Cleveland, Nov. 4, 1857. At the age of fifteen he was employed as a stove mounter by the old firm of Myers & Osborne. In 1897 he became connected with the Taylor & Boggis Foundry Co. as pattern maker. He left this firm to enter the employ of the Garland Foundry Co., now the Superior Foundry Co., where he was engaged as patternmaker, and later as head of the pattern department. He then became connected with the Interstate Foundry Co. in a similar position. During his entire life he lived and was employed in Cleveland. In 1913, together with D. J. Ryan and M. J. Sweeney, Mr. Sords was instrumental in launching the Allyne-Ryan Foundry Co., which quickly achieved a high standing in the manufacture of automotive castings. Mr. Sords was a member of the Cleveland Chamber of Commerce. He was married to Mary A. Logan more than forty years ago, and is survived by his widow and seven children, Mary M., Edmund A., Annette M., Frank J., Lenore A., John V. and Helen T. Sords.

Returns Have Been Slow

Fred L. Wolf, the Ohio Brass Co., Mansfield, O., chairman of the sand conservation and reclamation committee, is gathering data in response to a questionnaire sent out in August. This questionnaire was sent to nonferrous, gray iron, malleable and steel foundries to obtain information upon which to base investigational work for the joint molding sand research committee of the American Foundrymen's association and the National Research council. Intensive effort is being made to secure the answers to the questionnaire as early as possible and Mr. Wolf states that up to the present time the response of the industry has been unsatisfactory.

Steel Men on Committee

Federal Fuel Distributor Spens has just named a number of iron and steel men on his industrial advisory committee, which is to assist in the campaign to restrict purchases of coal to immediate needs, to unload cars quickly, to suspend stocking and to furnish the railroads promptly the materials needed to effect

repairs to railroad equipment. These are the aims set forth by the Chamber of Commerce of the United States at a conference with Secretary Hoover.

The steel men on the industrial advisory committee include James A. Campbell, Youngstown Sheet & Tube Co., Youngstown, O.; Eugene G. Grace, of Bethlehem Steel Corp., Bethlehem, Pa.; S. T. Bush, Buckeye Steel Castings Co., Columbus; R. P. Lamont, American Steel Foundries, Chicago; A. A. Landon, American Radiator Co., Buffalo; Joseph Inglis, American Blower Co., Detroit; and C. E. Foster, American Radiator Co., Chicago.

Discusses Cupola Practice

Samuel D. Sleeth, general foundry superintendent Westinghouse Air Brake Co., Wilmerding, Pa., was the speaker at the regular monthly meeting of the Pittsburgh Foundrymen's association, held at the General Forbes hotel Monday, Oct. 16, at 6:30 p. m. Mr. Sleeth discussed "Cupola Practice" and illustrated his talk with a number of lantern slides.

New Foundrymen's Society

Following lines already found successful in other trades in interesting the workers in scientific and technical development a technical society for foundrymen has been established at Sheffield, England. The new society was inaugurated early in September at a meeting held at the Sheffield university. W. Ripper presided and Percy Longmuir, past president and founder of the Institution of British Foundrymen, took an active part.

Creates Permanent Board

At the first meeting of the 1922-23 board of directors of the American Foundrymen's association held in Chicago Oct. 3, a permanent board of awards was created consisting of seven past presidents of the association. This board will be self perpetuating as each retiring president becomes a member, taking the place of the senior past president on the board. The junior past president will be chairman of the board.

Obituary

Richard Roberts founder of Richard Roberts & Son, Cardiff, Md., foundry and garage, died recently in his seventy-seventh year.

Frederick E. Anthony, consulting engineer for the Brown & Sharpe Mfg. Co., Providence, R. I., died at his home in that city, Oct. 8, on the fifty-eighth anniversary of his birth.

George Hoblizelle, 55 years old, vice president and treasurer of the Commonwealth Steel Co., St. Louis, died Nov. 5 at his home in that city after an illness of two years.

Dan Dow, 61 years old, president of the Grand Forks Foundry Co., Grand Forks, N. D., died recently. He operated the foundry for 37 years, going to Grand Forks from Fitzroy Harbor, Ont.

Fred Herbert Boardman, vice president of the J. D. Johnson Co., Inc., manufacturers of plumber supplies, with a foundry at Hainesport, N. J., and warehouses at Brooklyn, N. Y., Camden, N. J., and other cities, died at Mt. Holly, N. J., Tuesday, Oct. 24, 1922. Mr. Boardman was associated with the J. D. Johnson Co., for over 35 years.

James Francis Flynn, production manager and also one of the directors of the D. J. Ryan Foundry Co., Ecorse, Mich., died Oct. 16, 1922 in his 39th year. Mr. Flynn formerly was associated in the capacity of private secretary with H. O. Dunkle, assistant to the president of the Erie railroad. Later he went into business for himself as proprietor of the Peerless Bottling Works, Cleveland. He has been associated with the D. J. Ryan Foundry Co., since it succeeded the Ecorse Foundry & Machine Co., Feb. 1, 1919. Mr. Flynn is survived by a widow and four daughters.

Harry Jacob Frank Sr., founder of the Frank Foundries Corp., which operates plants at Davenport, Ia., and Moline, Ill., died recently, following an illness of six months. He was 72 years old. He was a native of Akron, O., where he was born Sept. 28, 1850. When he was 38 years old he went to Davenport from Denver and for 10 years was superintendent of the Davenport Machine & Foundry Co. He founded his own company in 1898 and in 1916 established the Moline plant. Mr. Frank's foundries in late years have specialized in automobile parts, engine blocks making up a large part of the output. Harry J. Frank Jr., vice president of the corporation, and A. E. Hageboeck, a son-in-law, secretary and treasurer, are among the survivors.

Chain Block Is Equipped with Motor Drive

With a view of serving for operations lying between the well defined field of the standard hand chain hoist and that of the traveling electric hoist, an electrically operated material handling device shown in the accompanying illustration has been placed on the market by the Motorbloc Corp., Summerdale, Philadelphia. It is claimed that this portable hoist may be installed without any engineering preliminaries in any location where electric current is available. The self contained pendant controller permits convenient operation immediately after the cord has been plugged into the nearest socket on the electric circuit.

The device consists of a standardizad

THE CONTROLLER IS OPERATED BY THE FINGERS OF ONE HAND

chain hoist, electrified by the application of a specially designed heavy duty motor, liberally proportioned reduction gearing and slip friction clutch applied by means of a malleable iron supporting bracket containing a self contained electrifying unit to which the pendant controller also is attached. The device is made up in units having a range of capacities from ¼ to 10 tons. The armature shaft and worm are carried in heavy duty ball bearings and liberal provision has been made for adequate, automatic lubrication.

The controller is operated by the fingers of one hand, thus leaving the other hand free to guide the load. The portability of the device is apparent from the fact that the 1-ton size only weighs 148 pounds. The operation of the machine is safeguarded by the use of the ring-

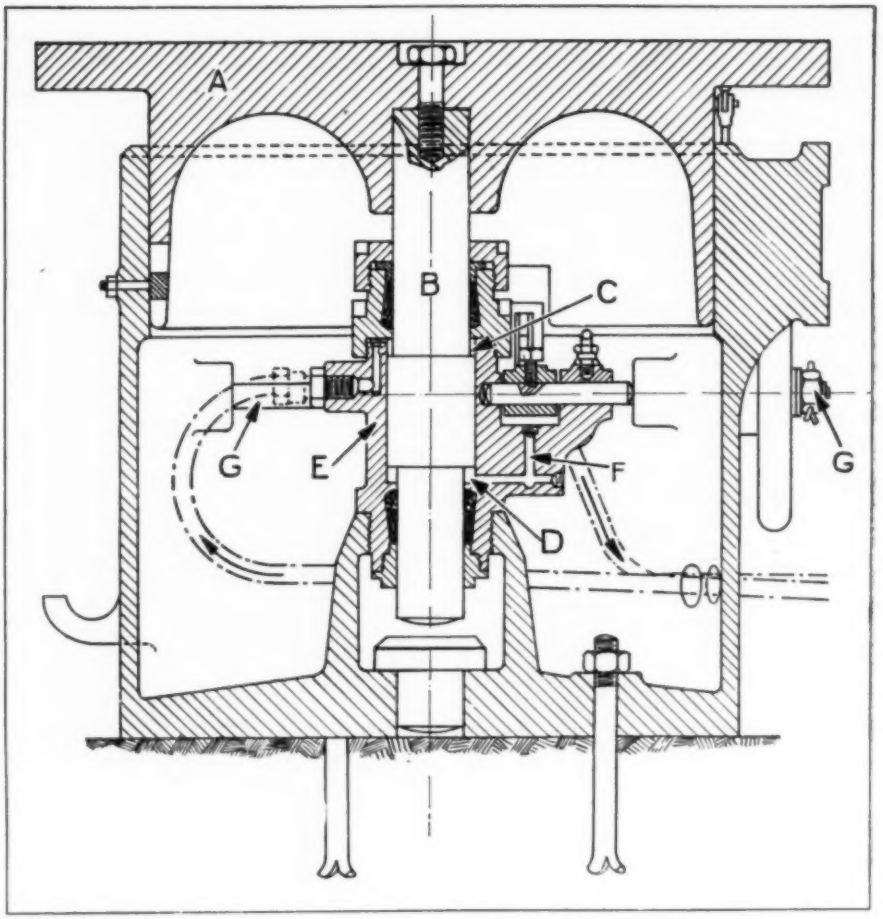
oiled slip friction clutch to prevent damage from over running to the hoist parts and chain and at the same time to protect the motor from overload without the complication of an electric limit switch. For occasional use where electric current is not available, or in the event of the electric power failing temporarily, the hoist may be operated as an ordinary chain block. The electrifying unit readily may be applied to hand chain hoists already in service.

French Jarring Machine Compact and Rapid

Vertical sectional view of a hydraulic ramming machine developed by the firm of Ph. Bonvillain & E. Ronceray, Paris, France, and exhibited for the first time at the exhibition held in connection with the convention of the Institution of British Foundrymen in Birmingham, England, in June, is shown in the accompanying illustration. This new, plain, jolt ramming machine is operated entirely by hydraulic power, using water at high pressure.

The ramming table *A* is carried on a plunger *B*, which is enlarged near the center so that two annular chambers *C* and *D* respectively are formed at the top and bottom of the hydraulic cylinder *E*. The upper chamber *C* is the smaller of the two and always is in communication with the accumulator.

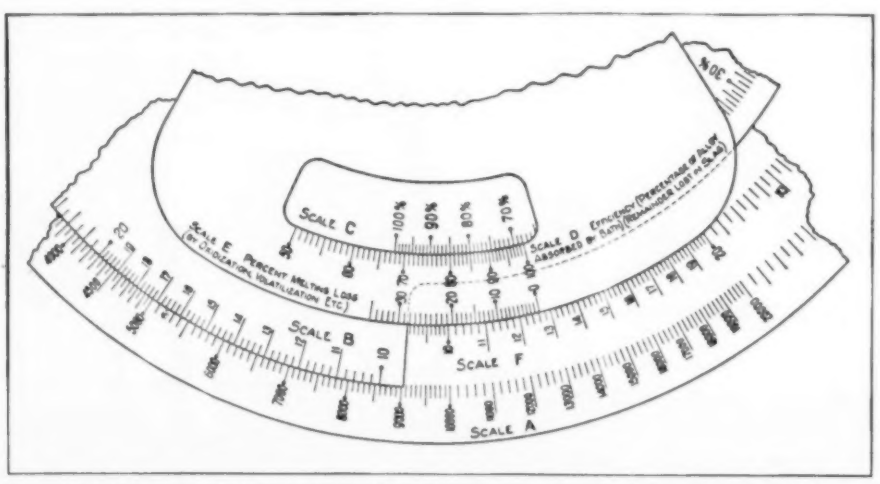
The water alternately is admitted to and discharged from the lower chamber *D* by a simple valve mechanism *F* operating from a shaft *G*. Water admitted to the lower chamber *D* raises the table *A* because the area of the plunger exposed in the lower chamber is greater than the area exposed in the upper chamber *C*. When the pressure is released the table is brought back to rest through the force of the pressure in the upper chamber *C* in addition to its own weight. The combination insures a sharp jolt without any rebound. The shaft *G* operating the valve may be rotated either by an electric motor, a small water turbine, or a ratchet gear engaging the table.



VERTICAL SECTION THROUGH CENTER SHOWING DETAIL OF CYLINDER AND PLUNGER

Slide Rule To Calculate Furnace Additions

The Pittsburgh Electric Furnace Corp., Pittsburgh, has put on the market a circular calculator, built along the principles of the slide rule, for calculating the weight of alloy necessary to add to get a definite amount into the bath. Six scales are used; four of them on two circular disks of white celluloid with a glazed finish, and two on a segment, all pivoted on a common center. Directions given on the back of the calculator indicate clearly how it is operated. Thus over the weight of the charge indicated by the scale *A*, shown in the accompanying illustration, the number of points of alloy to be added are set, as found on scale *B*. These scales are on the two circular disks which are then held together. Then, over the grade or percentage of alloy in the ferroalloy on scale *C*, the efficiency of absorption figure of the alloy on the scale *D* is set. Under the per cent of melting loss on scale *E* the number of pounds of ferroalloy required may be read. The following example explains this more clearly: Assume a charge of 6135 pounds; assume it is necessary to add 14 points (0.14 per cent) of manganese to the bath, using 80-per cent ferromanganese at 85 per cent efficiency of absorption and a melting loss of 3 per cent in the bath. To solve this set the figure 0.14 on scale *B* over 6135 on scale *A*, then set 85 on scale *D* over 80 on scale *C*. The answer 12.3 pounds of alloy addition, can then be read on scale *F* opposite 3 per cent melting loss, on scale *E*.



ALLOY ADDITIONS ARE CALCULATED ON A CIRCULAR SLIDE RULE

Equipment Demand Is Varied

Sales of Repair Parts and Light Sundries Maintain Market Activity, While Inquiry Continues for Heavier Foundry Machinery from Wide Sources

FALL sales of foundry equipment have maintained a high mark. The sustained activities of foundries, particularly in the automotive and railway equipment lines have resulted in a larger volume of buying of sundries and machinery than was anticipated. Sales of repair parts, vibrators, flasks and supplies have been large. Cleaning room equipment, grinding machinery, core ovens and sand mixing installations have been the center of much of the buying during the past two weeks, and the diversity of demand is indicated clearly by these unrelated items. The Abrasive Co., Philadelphia, is operating at 90 per cent of capacity and is contemplating plant changes and additions. Recent large sales of sand blast machinery are reported from all sections of the country. Among the contracts closed by the Pangborn Corp., Hagerstown, Md., were those with the Consolidated Rolling Mills & Foundry Co., Mexico City, Mexico, and the Springfield Malleable Iron Co., Springfield, O. The Berkshire Mfg. Co., Cleveland, recently has sold 12 molding machines to the Ford Co., Detroit, and in addition has a number of smaller orders, one for shipment to New Zealand. The Standard Sand & Machine Co., Cleveland, recently sold a continuous type sand mixer with a capacity of 25 tons per hour to the Lamb Machine Co., Hoquiam, Wash., and the same interest is figuring a 1-ton batch mixer for Pierce, Butler & Pierce, Huntington, W. Va. The Pittsburgh Valve & Fittings Co., Barberton, O., is figuring on the installation of complete powdered coal firing equipment. The Mayor Fuel Saving Furnace Co., Cleveland, is installing a portable furnace oven at the plant of the Otis Steel Co., Cleveland, and also is attaching furnaces to existing ovens in the converter department of the same company. Foreign inquiries of interest to foundry equipment manufacturers, full details of which may be obtained from the nearest office of the U. S. Department of Commerce, include No. 4321 from Hungary for air compressors and No. 4317 on grinding wheels, Italy.

No Outstanding Orders in the East

FOUNDRY equipment buying over the past two weeks has shown little improvement, according to most sellers in this district. Again, there have been no specially outstanding orders, but contracts have been sufficiently numerous to make for an increase in business. Demand for sand cutters is described by one seller as being the largest this year. Several sizable inquiries are pending, including a complete foundry outfit for the Burnham Boiler Co., Lancaster, Pa., which recently closed on 600 tons of steel for a new building, and a substantial list for a new foundry to be erected by the Bartlett Hayward Co., Baltimore. Another company likely to require equipment is the General American Tank Car Corp., putting up a plant at New Orleans. A recent buyer is the James Spence Iron Works, Jersey City, N. J., which has closed on a 10-ton electric crane, 40-foot span, to Alfred Box & Co., Philadelphia, and is still in the market for some other equipment. The Brooklyn Foundry Co., Brooklyn, has closed on a 2-ton electric crane, with 22-foot span to the Columbia Hoist & Machine Co., and the American Abrasive Metals Co., Irvington, N. J., also has closed on a 3-ton electric crane, 45-foot span, to the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Among the recent sales of sand blast machinery were installations contracted by the Pangborn Corp., Hagerstown, Md., for the American Radiator Co., and Pratt & Letchworth, Buffalo; the Jamestown Malleable Products Corp., Jamestown, N. Y., and the Stuart & Peterson Co., Burlington, N. J.

Note Decrease in Chicago Sales

A LULL in demand for general foundry equipment is noticed by sellers, but is not considered significant. Some tumbling barrels, ladles, cupolas and other general equipment is being ordered steadily, but the total has fallen off from that reached during recent weeks. Construction has been started on a gray iron foundry and machine shop for the Burnham Boiler Corp. at Lancaster, Pa., for which Frank D. Chase, Inc., is engineer. It will be equipped with monorail and other labor saving devices of the most modern kind. Work is proceeding on rebuilding the steel foundry of the Bucyrus Co. at South Milwaukee. The bureau of standards, Washington, has purchased an 18-inch test cupola from the Whiting Corp., Harvey, Ill. Crane selling has been fairly active recently. The Whiting Corp. has booked a 15-ton handpower crane of 42-foot span for the Wheeling Steel Corp., Wheeling, W. Va. The Alliance Machine Co., Alliance, O., has taken an order for 13 cranes for the new plant of the National Tube Co. at Gary, Ind., and the Shaw Electric Crane Co., Muskegon, Mich., has been awarded 28 4-rope, pipe-mill cranes for the same plant. Efforts to prepare sand for efficient molding is evident from sales of sand-preparing machinery. The National Engineering Co., Chicago, has recently sold foundry mixers for shipment to New Orleans, Toledo, Detroit and Quincy, Ill., and one to a foundry in France. The Keokuk Steel Castings Co., Keokuk, Iowa, the Lakeside Malleable Castings Co., Racine, Wis., have purchased sand blast installations from the Pangborn Corp., Hagerstown, Md. The Wisconsin Gray Iron Foundry Co., Milwaukee, is adding new cleaning equipment and doubling its melting and core department. F. C. Haack is in charge of the purchasing.

Buying Light in Pittsburgh District

ALTHOUGH inquiries for various kinds of foundry equipment still are before sellers in the Pittsburgh district, actual orders are few. These mostly are confined to the smaller supplies which always are needed and buying on a hand-to-mouth basis is expected to continue until after inventories have been taken. Equipment needed includes such items as foundry clamps, riddles, flasks, wheelbarrows, etc., but in these connections there has been no outstanding purchase so that actually no improvement is noted over the conditions prevailing for a month or two past. At times inquiries for ladles, industrial cars and molding machines come out, but buying for the most part is deferred. What actually is needed is being closed and sellers expect that this will continue to be the character of trading in these lines until after the first of the year. One or two complete

foundry equipment installations still are pending. In the case of large foundries, appropriations for equipment have been absorbed so that additional contracts cannot be awarded until the 1923 appropriations have been made. No interest at all has been manifested by foundry operators in air compressors for some time past, the Wilmerding, Pa., manufacturer not having heard from a foundry since the American Foundrymen's association convention and exposition several months ago. Several good sized inquiries for molding machines are current, but action on these likewise is deferred. Many foundries are having difficulty keeping present equipment engaged under restricted operations brought about by the car shortage and other causes. The Advance Foundry Co., Dayton, O., is in the market for a 10-ton crane and several foundries nearer by want hoists. One or two steel foundries likewise are interested in crane equipment. The Cutler Steel Co., New Cumberland, W. Va., wants a 10-ton crane, the Universal Steel Co., Bridgeville, Pa., a 7½-ton crane, and the Guibert Steel Co., Diamond Bank building, Pittsburgh, a 5-ton crane. Two more second-hand cranes have been sold by the Reliance Machiney Sales Co., from the equipment stock of the Marshall Foundry Co.'s plants which are being dismantled. One 15-ton and one 20-ton cranes have been sold to Pittsburgh manufacturers. Recent purchasers of sand blast equipment from the Pangborn Corp., Hagerstown, Md., include the Frick Co., Waynesboro, Pa., and the Manufacturers Foundry Co., Sinking Springs, Pa.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Bids have closed for a laboratory building for the Moore Drop Forging Co., Chicopee, Mass.

The Bartlett Hayward Co., Baltimore, plans a 1-story foundry building, 202 x 262 feet.

The Logansport Radiator Equipment Co., Logansport, Ind., plans a plant addition.

The National Cast Iron Pipe Co., Birmingham, Ala., is planning plant additions for the manufacture of centrifugal pipe.

The New Haven Malleable Iron Co., New Haven, Conn., has purchased five acres adjoining its plant to provide for future expansion.

The Parker Wire Goods Co., Worcester, Mass., is having plans prepared for a plant on the site of the former Star foundry.

The Advance Foundry Co., Dayton, O., plans extensions and improvements to its plant, including the installation of new equipment.

The M. & A. Brass Foundry Co., Dayton, O., has been incorporated with $10,000 capital stock by John J. Hall, V. J. Sanborn, and others.

The Portsmouth Stove & Range Co., Portsmouth, O., has awarded a contract for an addition to its foundry.

The International Harvester Co., 606 South Michigan avenue, Chicago, plans a 1-story foundry building, 40 x 213 feet.

The Porcelain Enamel Mfg. Co., Baltimore, plans to rebuild its plant recently damaged by fire.

The American Steam Pump Co., Battle Creek, Mich., plans a 1-story addition, 50 x 60 feet, to cost about $20,000.

The Lynchburg Foundry Co., Lynchburg, Va., plans to rebuild the portion of its pattern shops recently damaged by fire.

A permit has been granted to the Madison Pattern Works, Madison, Wis., for a $15,000 shop addition.

A new foundry has been completed by the Imperial Electric Co., Akron, O., and outside work in brass castings is being taken on. The last of the new equipment was installed recently.

The Hummel Steel Foundry Co., Conshohocken, Pa., has been incorporated with $10,000 capital stock by George W. Corbett, 63 High street, Pottstown, Pa., and others.

The Gloekler Mfg. Co., Pittsburgh, has been incorporated to manufacture refrigerators, etc., with $5000 capital stock by Karl J. Gloekler, Martin A. Gloekler and Michael Enz.

Part of the foundry of the Extension Radiator Works, Huntingdon, Pa., operated by the Pierce, Butler & Pierce Mfg. Corp., Syracuse, N. Y., recently was damaged by fire.

The Pennsylvania Steel Castings Co., Hamburg, Pa., has been organized with $50,000 capital stock by W. Morris Deisher, W. Stewart Wray and B. L. Roth.

The Chamber of Commerce, Lima, O., has closed negotiations with the Pittsburgh Engineering Co., Jeanette, Pa., to remove its plant to this city.

The Seaboard Foundries, Inc., Brooklyn, N. Y., has been incorporated with $110,000 capital stock by Hubert W. Eldred, 105 Fourth street, Ridfield Park, N. J., and others.

The Binghamton Foundry & Machine Co., Inc., Binghamton, N. Y., has been incorporated with $250,000 capital stock by R. S. Cooper, and others.

The Seaboard Brass & Copper Co., Baltimore, has been organized with $100,000 capital stock by B. H. Rollin, H. F. Bennett and C. W. Smith.

The Kokomo Malleable Iron Works, Kokomo, Ind., has been incorporated with $550,000 capital stock by J. W. Johnson, Charles T. Byrne, John P. Grace, George Kingston and A. G. Seuberling.

The General Alloys Co., Boston, has been incorporated with $400,000 capital stock to make castings, etc., by Henry H. Harris, Chicago, and Charles Van Stone and Edward P. Van Stone, both of Reading, Mass.

Work has been started on the new plant of the Center Wheeling Machine & Foundry Co., Wheeling, W. Va., which is expected to be completed by Jan. 1. The new buildings will provide larger quarters than those now occupied.

Skagerberg Bros., Inc., Bellwood, Pa., have been incorporated with $25,000 capital stock to carry on a general machine shop and foundry business by Richard E. Skagerberg, John A. Skagerberg and J. Walter Skagerberg.

The Alloys Foundry Co., 407 Dearborn street, Chicago, has been incorporated with a capital stock of $6000 to manufacture and deal in metal products. The incorporators are Charles B. Carter, Samuel W. Booth Jr., and Allen Erickson.

Brass, bronze and aluminum castings of all descriptions, pattern castings and match plates are being produced by the City Foundry Co., 1299 Broad street, Hartford, Conn. The company recently started in business. Partners in the organization are W. R. Haupt and C. A. Belanger.

The Kokomo Malleable Iron Co., Kokomo, Ind., has become the Kokomo Malleable Iron Works, Inc., with a capital stock of $550,000 and will be managed by the same board of directors as that which directs the Hoosier Iron Works. It is headed by J. W. Johnson of Kokomo. The two corporations will be entirely separate, according to Mr. Johnson.

New Trade Publicaitons

LOCOMOTIVE REPAIRS—The Metal & Thermit Corp., New York, has published the fourth edition of its locomotive repair pamphlet which should be of especial interest to railroad superintendents of motive power, general foremen, blacksmith foremen and welders. The pamphlet contains many revisions of data given in the former one, chief among which are instructions for applying important improvements in practice in welding. The drawings and instructions illustrating and describing metal welds in various parts of locomotive frames and other locomotive and railroad equipment have been completely revised.

FLOORS—The Marine Decking & Supply Co., Philadelphia, has published 24-page illustrated booklet in which modern flooring practice is described and illustrated. The booklet chiefly is devoted to describing flooring material manufactured by the company. This material is said to have given exceptionally satisfactory service upon the decks of ships and in industrial plants. The principal ingredient is calcined magnesite, which is mixed dry with certain fillers to give the finished floor a hardness commensurate with elasticity. To this is added a magnesium chloride solution which brings it to a plastic state in which it is applied to the floor or foundation. The composition hardens over night, presenting a smooth, level surface unbroken by seams. It is noninflammable.

TRUCK TRAILERS—A 32-page illustrated booklet issued jointly by the General Motors Truck Co., Pontiac, Mich., and the Detroit Trailer Co., Detroit, presents complete tractor and trailer information. This, it is claimed, is the first time data covering both units necessary for modern highway transportation are brought together in convenient form. Both the tractor and trailer are described and illustrated in detail and in addition numerous illustrations show both in operation. A chart in the back of the booklet, showing five systems of modern highway transportation is interesting.